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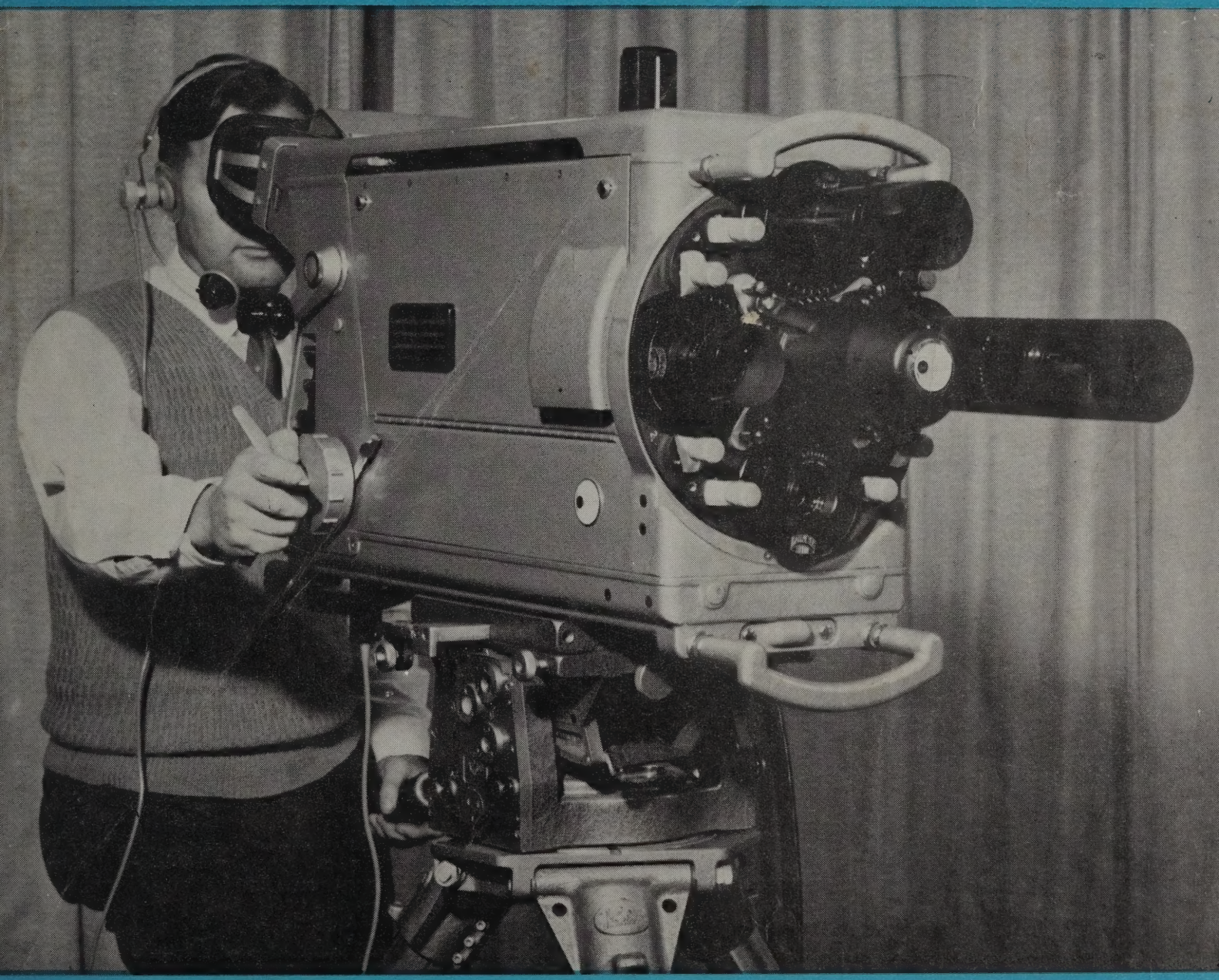
MAY 1, 1962

TV • AUDIO • SERVICE • AMATEUR RADIO



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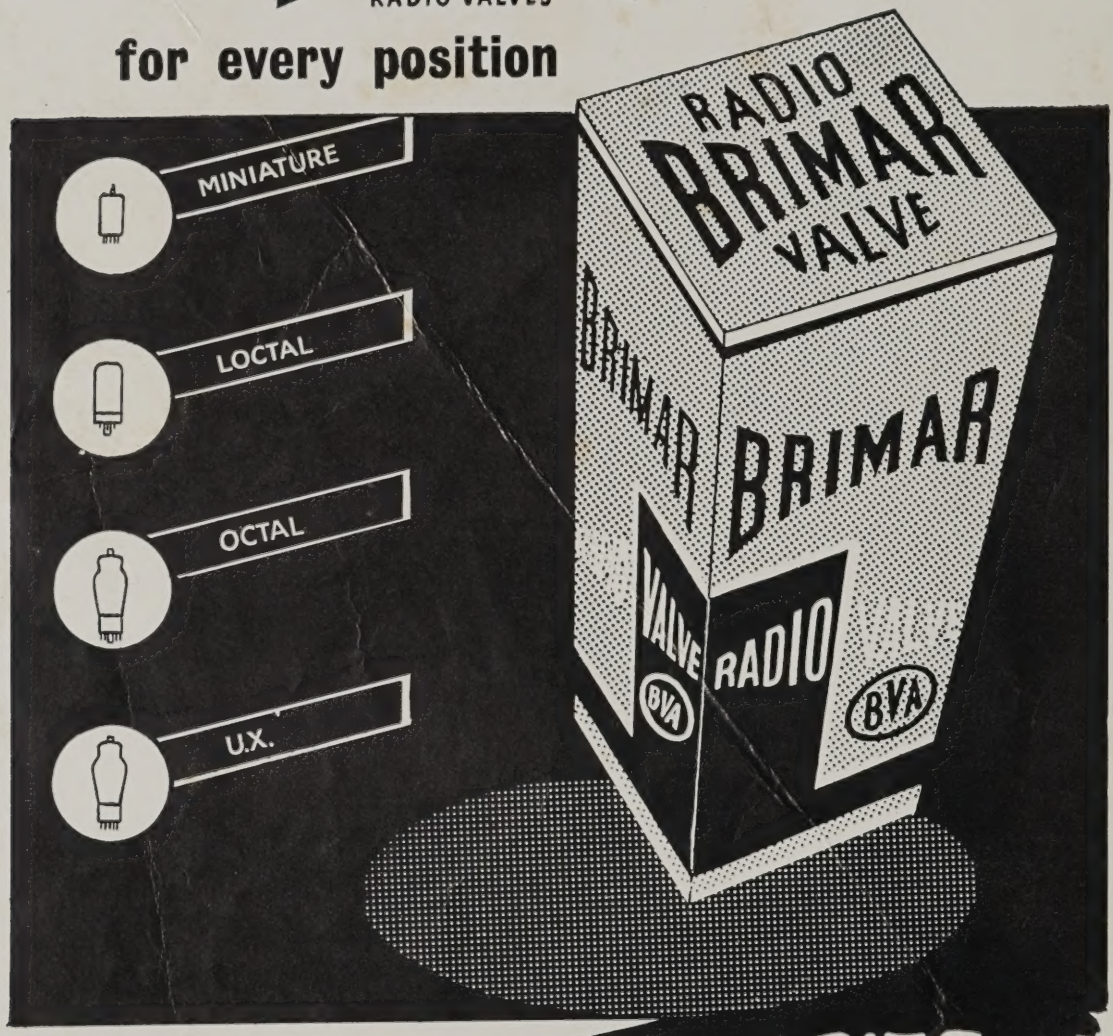

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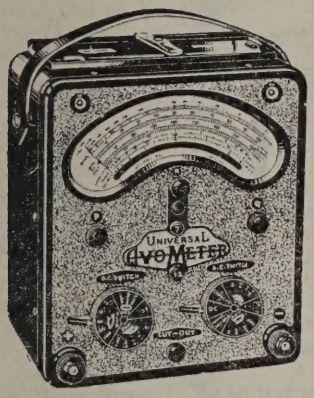

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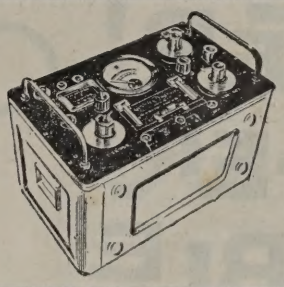

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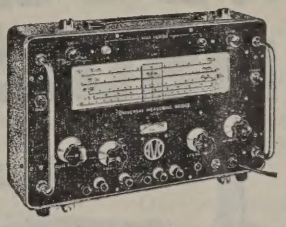
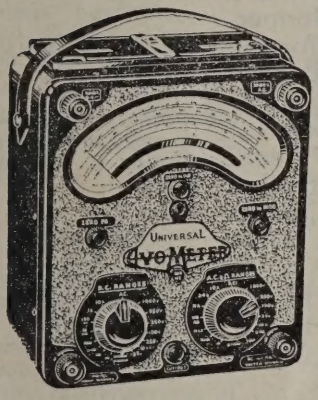
A self-contained, mains driven instrument for the accurate measurement of resistance, capacity and inductance over an extremely wide range.





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Has a sensitivity of 20,000 ohms per volt on all D.C. voltage ranges and 1,000 ohms per volt on A.G. voltage ranges from 100v. upwards. Retains traditional simplicity of operation and compact portability of the Model 7 Avometer.

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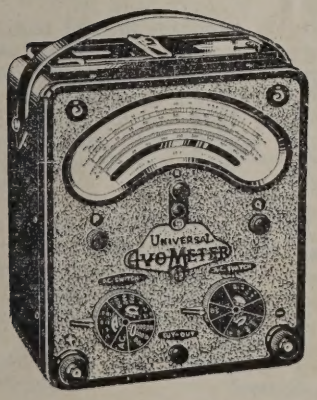
This instrument consists basically of a balanced bridge valve voltmeter and has a wide set of ranges. It is almost impossible to damage by overload.



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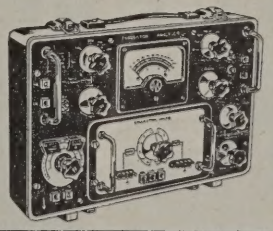

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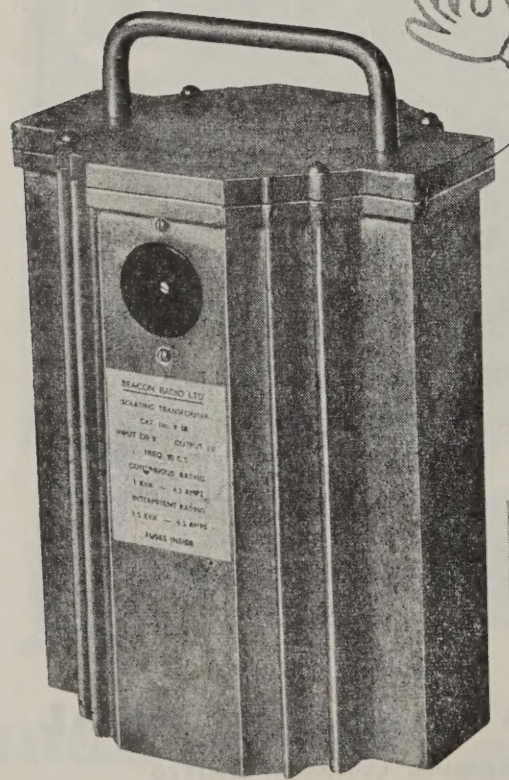

All outdoor electrical equipment should have an isolating transformer. And the best one for the job is this new Beacon Transformer. Cast aluminium case makes it lighter. Complete redesigning makes it smaller. Double insulation makes it completely safe. Sizes range from 250VA up to 3KVA continuous rating.

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Letters from Readers

BOUQUETS . . .

We have received many complimentary letters in response to our recent request for opinions on development. We have chosen two for publication, and would like to thank the many readers who took the trouble to write in.—Ed.

Sir,

I would like to congratulate you, first, on your Communications issue — it was splendid (topical and up-to-date) and, secondly, on your new format—Just before the change-over, I was about to cancel my booking for the magazine but am now very pleased I "gave it a go." Your March issue, what I have glanced at so far, is very good and I hope you manage to keep this standard up. As an ex-R.N.-Z.N.C. Radio Mech. (Pacific), I am now more interested in Wide Range Audio equipment, but find anything "electronic" interesting.

DOUGLAS W. BESWICK.
Cambridge.

Thank you for your interest in the magazine—hope this issue is as pleasing.—Ed.

* * *

Sir,

In your March issue, just to hand, it is noted that you desire an expression of opinion on the developments that you have so far made with the rearrangement of the magazine.

I should like, in response to that request, to express my satisfaction and pleasure at the presentation of 'Radio and Electrical Review' and the varied and interesting subject matter of the articles therein.

The monthly departments, in particular 'Shortwave Survey' and various constructional projects are very much appreciated and it is to be hoped that they will be maintained at the present high standard.

In conclusion I should like to say—Keep on with the good work.

E. W. JEFFERIS.
Manurewa.

Thank you for your kind remarks. We intend not only to keep up the good work but to surpass ourselves within the next few months. —Ed.

* * *

HELP WANTED

Sir,

Is it at all possible for me to obtain from you a copy of May 1st, 1955 Radio and Electrical Review ? There are two circuits in this copy I want—one is the circuit, etc., on the 38 Transceiver (which I have been after for several years) and the other is the circuit of a two Transistor portable radio. Also could you please let me know what substitute Philips are using for the OC51 which is in this circuit. Also have you any later editions of this magazine with small Transistor circuits?

S. J. RUSSELL.
Palmerston North.

A full reply has been mailed to you. We regret that we have been unable to obtain any back numbers from the previous publishers. Perhaps one of our readers in Mr. Russell's area could lend him a copy of that issue? If so, please send it to 88 Rugby Street.—Ed.

* * *

ENGLISHMAN'S DILEMMA

Sir,

Since arriving here from England last February I have often wondered why the Electrical Trades Registration Board, and no other trades, make it so difficult for people wishing to enter the radio/electronics industry who are recognised in their own countries. I say this because, although I have been given approval to sit the radio trades exam, the next one being in November, I find it impossible to obtain employment in the trade without moving to one of the three main cities of New Zealand as small firms are not allowed to employ journeymen unless they have registered men at the required ratio. It seems also that one cannot take the Government sponsored correspondence course until one is engaged in the trade. Rather a stalemate!

If I may say, I would like to make a suggestion about your magazine. Would it be feasible to encourage the firms who advertise in your magazine to also advertise their personal requirements?

Yours faithfully,
F.G.S.
Eltham.

Your suggestion will be kept in mind—we do run a classified ads section for situations vacant, for sale, etc. Perhaps one of our readers could help. Please forward any information to us and it will be passed on. —Ed.

* * *

NO MUSIC

Sir,

The enclosed circuit is the phase inversion detector and AVC stage of a radio receiver and amplifier.

Please advise how to connect a guitar pick-up to this circuit.

We have tried breaking circuit at the point X and feeding the pick-up in there but without result. However, if the guitar pick-up input lead is placed on either point A, the signal will pass through the amplifier.

We have been careful to apply earth returns in either case.

The failure at point A may have to do with out of phase voltages.

ALLAN E. BALL.
Northland.

Using this circuit as it stands, there is no way that the guitar pick-up can be fed into the amplifier to give the correct type of operation. However, a full explanation has been mailed to you.—Ed.

* * *

LIKE FATHER—
LIKE SON

Sir,

Your offer of a circuit diagram of the tuning and signal strength meter would be appreciated. We would look forward to receiving this circuit at your earliest convenience.

Our communications receiver is home built using a Denco turret tuner with double conversion to 455 k.c. A 6H6 is used as the detector and noise limiter circuit, so it would appear that a separate triode would be used in the signal strength meter circuit or the 6H6 be replaced with a 6SN7-GT as used in your equipment.

My young son has derived great pleasure from your Shortwave Survey articles and has them all carefully filed. Thanking you in anticipation.

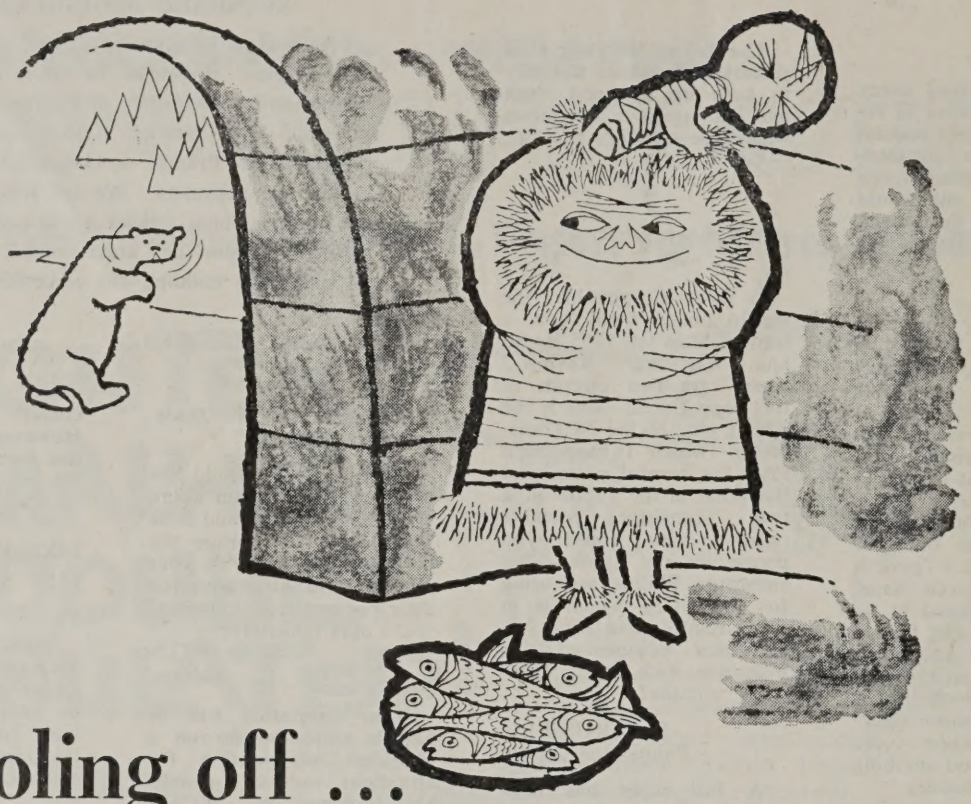
ALLAN E. BALL.
Matakohe, Northland.

Thank you for your letter and your appreciative comments about "Shortwave Survey." Your communications received would appear to be capable of very good performance and I would be pleased to hear from you again regarding any interesting reception obtained through its use.

I have forwarded you the circuit diagram of the S-meter used here and trust that you will find this facility as useful as I have found it to be—Mike Butler.

PAPAKURA BRANCH, N.Z.A.R.T., ADOPTS R. & E.'S "TRIPLEX RECEIVER" AS STANDARD BEGINNER'S PROJECT

As we go to press, we are gratified to learn that the "Triplex" Broadcast Receiver, designed by Irving Spackman and described in February and March issues of Radio and Electrical Review, has been adopted by the Papakura Branch of N.Z.A.R.T. as their standard project for beginners. We are very glad to know that our constructional articles are arousing interest amongst those for whom they are intended, and we wish them all success in building this equipment.



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G.C./2/61

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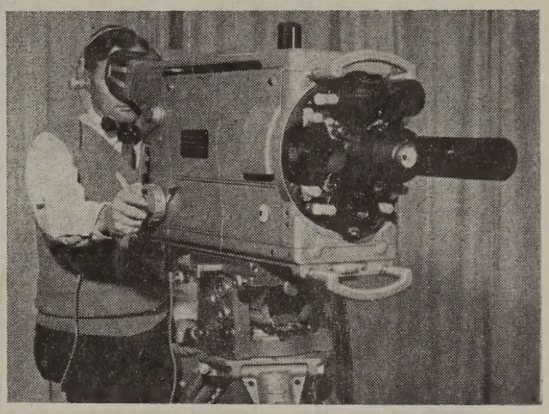
On Our Cover



This month's front cover depicts a Marconi Mark 1V Image Orthicon Television Camera in use in an N.Z.B.C. Studio in New Zealand.

These Marconi Mark 1V 4½-inch Studio Cameras have been supplied to all N.Z.B.C. Studios throughout New Zealand and are incorporated in the Marconi Television Outside Broadcast Vans used by the N.Z.B.C.

Marconi Television Transmitters, associated Vision equipment, Tele-Cine Channels and Television link systems for Auckland, Wellington, Christchurch and Dunedin Stations, were supplied to the N.Z.B.C. by Amalgamated Wireless (A'Asia) N.Z. Ltd.

Featured Next Month

- ☆ An Advanced Mobile Receiver
- ☆ Looking at Ceramic I.F. Filters
- ☆ Moleculer Electronics

OVERSEAS NOTEBOOK : NEW PRODUCTS : SHORTWAVE SURVEY : TECHNICAL JOURNALS CONTENTS

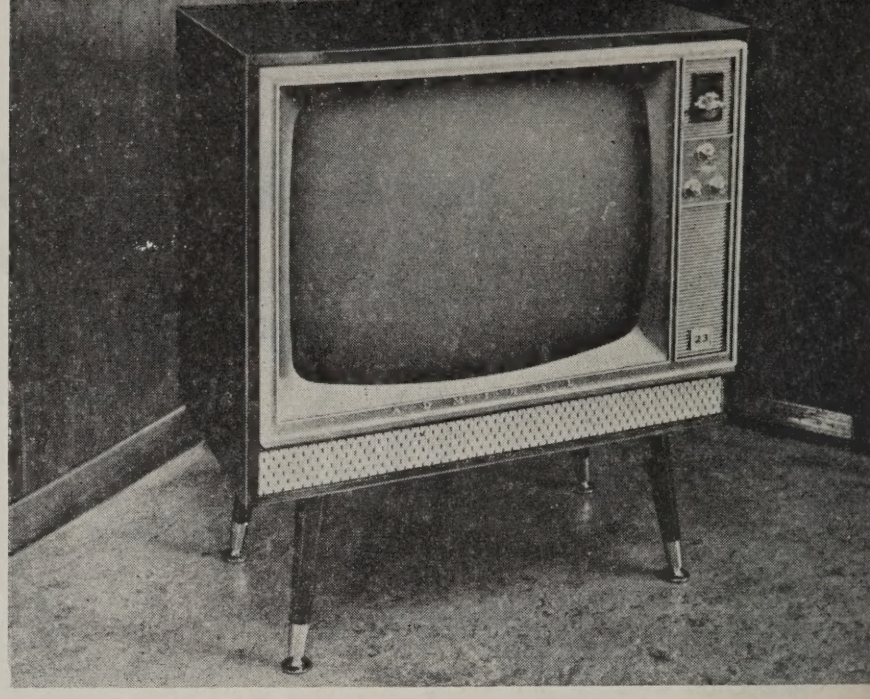
Collier & Beales Admiral "Pasadena" Selected for D.A.N.Z. Exhibition

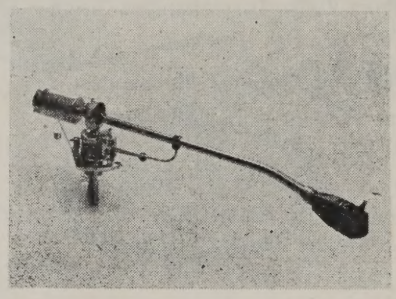
Following "Design Magazine's" recent appraisal of English TV receivers (March '62 "R. & E."), it is interesting to note that this locally manufactured set was selected for the recent inaugural Exhibition of the Design Association of New Zealand.

The Admiral "Pasadena" was developed by the engineering team of Admiral of Australia at Bankstown, N.S.W. It represents a modern concept of a twenty-three inch receiver taking the minimum of floor space, yet having all the user controls on the front, rather than the peculiar practice of placing them on the cabinet side. The speaker is close to the screen, thus giving proper presence to the picture.

A bonded tube is used which eliminates the flat safety-glass—with the problem of between-glass dust removal. By having only one glass-to-air surface, reflections on the screen are reduced by two thirds. Bonded tubes can be relatively "flatter," thus making a wider viewing angle without picture distortion.

The escutcheon finished in grey and ivory, is a diecasting which reinforces the cabinet and supports the picture tube. The channel selector numbers are projected, this serving also as a pilot light. The cabinet is hand polished in mahogany and walnut to a high gloss.





DESIGN CENTRE AWARD 1962

For the 1962 Awards, the choice was made from the 3,000 exhibits which have been displayed in The Design Centre during 1961.

All the products are in Design Index and, as such, must satisfy those tests of technical efficiency that are revelant. Reports of such tests were available to the judges.

Amongst the awards was this Precision Pick-up Arm, designed by A. Robertson-Aikman and W. J. Watkinson and manufactured by S.M.E. Ltd. This equipment retails for £28/3/9 (12 ins.); £25/12/6 (9 ins.) in the U.K.

The Judges comment: "The judges, having seen comparable arms of both British and foreign manufacture, were convinced by the evidence of technical reports that this arm offers an outstanding performance. It also looks what it is, a fine piece of precision engineering. They liked the interrelation of circles and cylinders at the counterbalance, and were pleased to hear that the bias adjuster, at present attached as an added technical refinement, is to be incorporated into the body of the design. The judges considered the product a satisfying solution to complex technical problems."

About the product: Engineered throughout to instrument standards, with all parts precision machined, heat treated and ground where necessary, the arm is finished in satin chrome plate, gun black and polished stainless steel. The height of the pillar is adjustable through 1-in. The bed plate is mounted through four soft rubber grommets to reduce the transfer of mechanical vibration and permit minute tracking adjustment. The weight system provides longitudinal and lateral balance adjustment. The black plastics shell is fitted with detachable pillars and fixing screws to take any standard mono or stereo cartridge. Beneath the base is a screened four-pin plug and socket, providing a rigid support for the "hard" wiring and the delicate pick-up lead, thus eliminating a common cause of influence on the tone-arm movement. Precision ball races and knife edge bearings reduce friction at the vertical and lateral bearings, the wood lining dispels resonances from the arm and the balance system is mounted on a compliant coupling. To simplify adjustment of the arm to provide whatever tracking pressure is required, the "rider" weight is mounted on a scale marked in half grammes. This system of weights is so efficient that even if the turntable and arm are tilted through 30° from horizontal the quality of reproduction is not affected. The built-in lowering and raising gear, which is hydraulically damped and controlled by a lever, enables the arm to be placed anywhere on a record without risk of damage. A technical refinement added to the SME arm is the bias adjuster, a small weight attached by nylon thread to a calibrated lever mounted on the bearing assembly. This counteracts the tendency of all pick-up arms to move towards the centre of the record. An independent assessor reports that this arm embodies every desirable feature essential for high quality sound reproduction. Although the initial cost is comparatively high, correctly installed it should virtually eliminate record wear. This pick-up arm is already in demand in the United States, France, Holland, Belgium, Sweden, Switzerland, South Africa and Australia, apart from the home market.

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DAWE Transistor Phase Meter—Type 630A.
Price, £110.

SPECIFICATION:

Phase Angle Ranges: 0°—360° or 180° — 0° —180°

Input Voltage and Impedance

30 V — 300 V r.m.s. — 10 megohms
3 V — 30 V r.m.s. — 1 megohm
0.3 V — 0.3 V r.m.s. — 10 k
0.3 V — 3 V r.m.s. — 100 k

Please reply: P. L. Watts, P.O. Box 5740, Auckland.

I.R.E.

Golden Jubilee, May, 1962

Fifty years ago, this month, the Institute of Radio Engineers was founded in a hall in Columbia University, New York City. A Constitution was approved by the original membership of 46, composed of existing members of two other organisations, the Society of Wireless Telegraphic Engineers, founded in 1907; and the Wireless Institute, inaugurated in 1908.

A year later, in June 1913, it was decided to incorporate the society and consequently, the organisation was incorporated under the laws of the State of New York.

In brief, the expressed aims of the new Association were: "To advance the art and science of radio transmission, to publish works of literature, science and art for such purpose, to do all and every act necessary, suitable and proper for the accomplishment of any of the purposes or the attainment of any of the powers herein set forth, either alone or in association with other corporations, firms or individuals, to do every act or acts, thing or things, incidental or appurtenant to or growing out of or connected with the aforesaid science or art, or power or any parts thereof, provided the same be not inconsistent with the laws under which this corporation is organised, or prohibited by the State of New York."

One of the most important functions of the Institute was to preserve its technical papers and the remarks made regarding them; in published form. Consequently, one of the early decisions of the Institute was to publish a technical magazine which was named the "proceedings of the Institute of Radio Engineers." The first issue was dated January, 1913.

This was established first as a quarterly volume. In 1916, publication was increased to six issues per year, whilst since 1927, the Proceedings have been published monthly. The original year's four issues, comprised a total of 268 pages, or an average of 67 per issue. Compared with this, the 50th Anniversary Issue of over 1,200 pages, which took many months to prepare.

The original register of the Institute in which the names of the early members were recorded constitutes a veritable Who's who of the early history of Radio. Just to mention a few who have made their mark in the early days of radio and electronics, Lee de Forest and David Sarnoff, both associated with the thermionic valve, C. H. Collins Jr. and A. E. Kennelly.

At the inauguration of the Institute there was a considerable temptation to add the word "American." This was resisted however, because it was expected that, as the I.R.E. was then the only radio engineering society in existence, it would be international in scope; an expectation that was promptly realised.

In 1914, there were members in eight countries other than the United States. In 1961, out of a total membership of 96,000, over 6,500 members are resident in 90 countries, other than the U.S.A.

In 1948, the Governing Board of the I.R.E. authorised the establishment of Professional Groups, providing for sections within the framework of the I.R.E. to cater for technical specialisation of its members. The first two were known as the Audio Group and the Broadcast Engineering Group. At the end of 1961 there were 20 such groups established and some of these have organised extensive activities such as conferences and symposia; some of these during the past year were: The Fifth National Symposium on Global Communications; the National Symposium on Engineering writings, and speech; Symposium on Electromagnetism and Fluid dynamics of Gaseous Plasma; and the National Symposium on Space Electronics and Telemetry.

These various groups also publish periodically, collections of selected articles and papers entitled the "Transactions of the Professional Groups." In 1961, 102 issues of transactions were published by 28 groups, containing a total of over 1200 papers. The total annual publication of "Transactions" now exceeds in volume that published in the "Proceedings."

In view of the these advances, it is perhaps fitting that one section of the 50th Anniversary issue should be devoted to conjecturing what electronics might be like 50 years ahead, in 2012 A.D., whilst also looking back over the past 50 years and noting progress which has been made.

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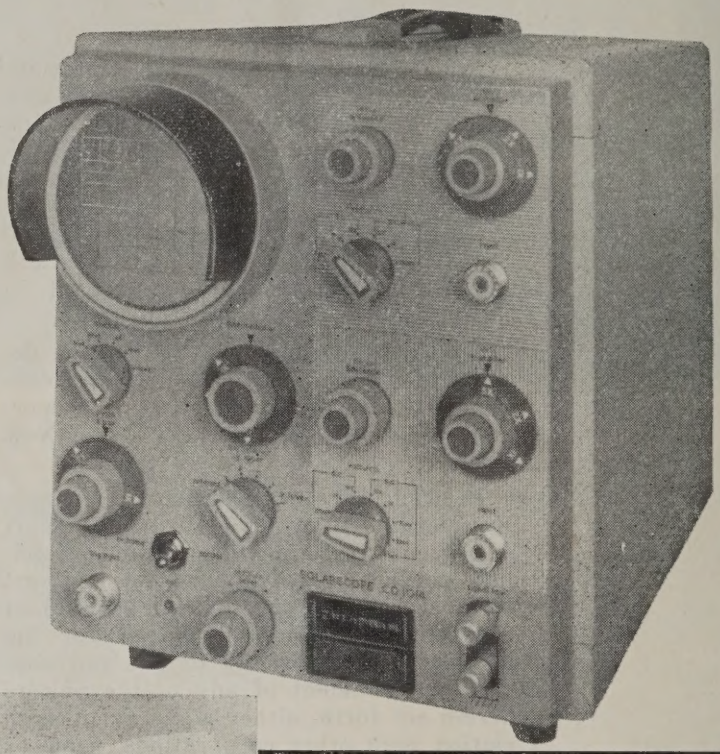

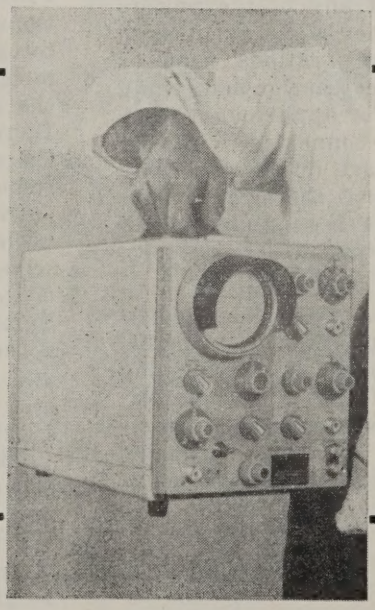

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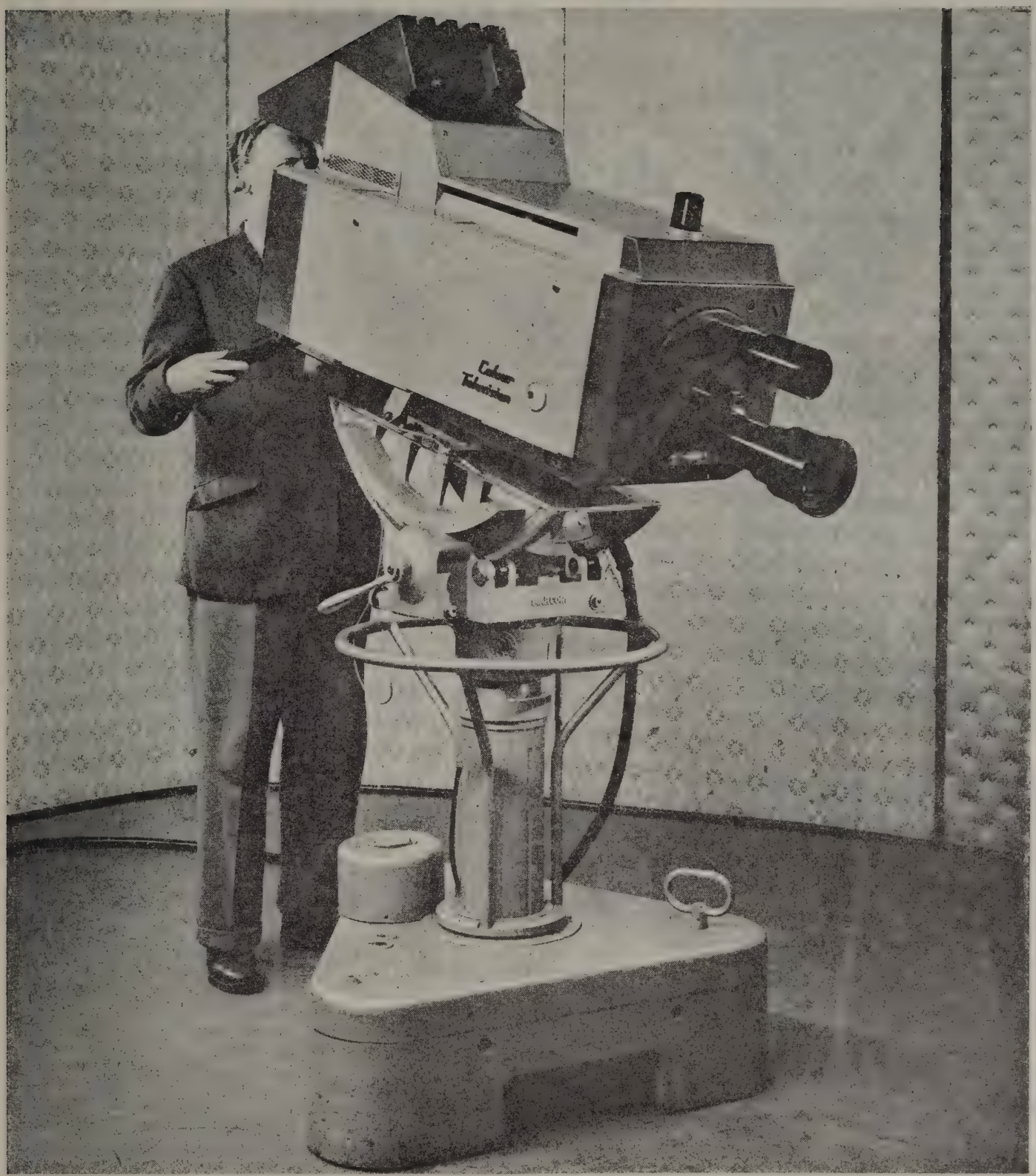

MARCONI 3-INCH IMAGE ORTHICON COLOUR TELEVISION CAMERA CHANNEL TYPE BD 848

The new Marconi 3-inch image orthicon colour television camera channel Type BD 848 recently made its first appearance in public at the National Association of Broadcasters' Convention in Chicago.

The BD 848, which employs three 3-inch English Electric Valve Co. image orthicons provides good quality colour pictures at light levels of approximately 250 ft. lamberts (2500 lux) and is suitable for studio or outside broadcasts. It is so stable in operation that the cameraman has no more controls to operate than on a Marconi Mark IV black-and-white image orthicon equipment. Picture shows the camera in operation.

Marconi's Wireless Telegraph Co. Ltd.—Marconi House, Essex, England.

Top: The Leak "Sandwich" loudspeaker cone supporting the weight of a man and thus demonstrating its great rigidity. The cabinet alongside shows the complete Leak "Sandwich" loudspeaker system as a model of compact housing.

Lower: An engineer demonstrating the versatile two-channel E.M.T. tape recorder. A new, professional transportable recorder, it is equally suitable for applications as varied as recording chamber music or the roaring blast, of jet aero engines.

BIG STRIDES ON ROAD TOWARD PERFECT SOUND REPRODUCTION

J. STUBBS WALKER

The constant search, everywhere in the world, for higher quality sound reproduction, particularly in the home, has been given fresh inspiration by developments announced by the manufacturers of audio equipment in Britain.

This year's International Audio Festival and Fair in London, could in fact, be looked upon as something of a landmark in the progress of "hi-fi."

For a long time, the weakest link in the chain of equipment needed for really good quality sound reproduction has been in the loudspeaker systems. The major improvement in speakers took place 36 years ago, with the invention of the moving-coil loudspeaker by Rice and Kellogg. Since then, this type of speaker has remained much as it was originally conceived. There have, of course, been improvements such as high-efficiency magnets, ultra-light-weight coil systems and the introduction of coaxial diaphragms to give wider frequency coverage. But, until now, there has been no significant change.

Important Developments

One of the most important developments is the production of an entirely new type of diaphragm. The theoretically perfect loudspeaker cone should have infinite stiffness and negligible mass, enabling it to work like a piston, translating the electrical signals provided to its coil into air movements. This theory of perfection cannot be met in practice, and various degrees of compromise have had to be accepted.

A new British development, however, has made use of the strength-weight ratio of expanded plastics to produce a cone that is both light in weight and extremely stiff—several hundred times stiffer, in fact, than any conventional type of cone produced during the past few years.

The plastics material forms the "meat" in a sandwich of extremely light metal to which it is bonded and the result is a structure of sufficient strength to stand a man's weight. When one recalls the expensive damage that could be caused to a loudspeaker cone by the ill-placed pressure of a thumb, this is a remarkable achievement.

The audible result is equally remarkable. The stiffness of the cone overcomes one of the principle disadvantages of conventional flexible cones, which have had a tendency to vibrate in unwanted modes. These "break-up" vibrations, being uncontrolled by the speech coil, result in cross-modulation and amplitude distortion.

Mr. Harold Leak, of H. J. Leak and Company (1) which has produced the new speaker, is internationally known as a designer of high-fidelity amplifying equipment which is used all over the world, but his new "Sandwich" speaker can be expected to make a bigger impact on the world of "hi-fi" than anything he has so far produced.

Small Cabinet

Manufacturers have appreciated the shortcomings of the conventional loudspeaker, and several have announced improved systems. Apart from the greater efficiency of the "engine" that drives the speaker—the moving-coil system—a great deal of development work has followed laboratory research into loudspeaker enclosures.

Not long ago, the "box" in which a speaker was mounted required to be an enormous affair to obtain good sound, and it was considered a theoretical impossibility to reduce the size of the cabinet without sacificing quality. Now, however, many manufacturers have been able to produce speaker systems which are housed in comparatively small enclosures.

Electrostatic Speaker

A case in point is the Wharfdale "Slimline" (2) a cabinet measuring only 25 inches (63.5 centimetres) by 20 inches (50.8 centimetres) and seven inches (17.78 centimetres) deep, which houses two speaker units and can confidently be classed as high-fidelity equipment.

An interesting point in the development of small speaker enclosures is that designers have been spurred on in their research by the demands of women. The increased popularity of stereo reproduction, requiring two loudspeakers, was threatened by the feminine objections to having two large cabinets in one room.

Another outstanding British loudspeaker is the "Accoustical Quad" (3) electrostatic speaker. This is entirely different from the moving coil technique, using the variations of voltage loading on two plates of a condenser to produce the sound vibrations. The "condenser" consists of an area approximately a metre square which is itself the radiating surface. This system is not new, but the improvements that have resulted from the use of new materials are notable and full frequency range, coupled with lack of artificial colouration of the sound, has resulted in its widespread use for the quality monitoring of gramophone recordings.

In amplifying equipment there were no developments of particular technical importance, though several manufacturers added refinements of interest. One of these is the Clarke and Smith (4) "Stereoscope" used in their quality stereo amplifiers. It consists of a one-inch (25.4 millimetres) cathode ray tube, the trace on which indicates whether the two outputs of the stereo amplifier are in balance. It can also be used to check the overall response of the equipment.

Mullard (5) introduced a new valve which greatly simplifies the building of stereo equipment. Known as the ECL 86, it is a triode-pentode around which a single-valve 3-watt amplifier can be designed, requiring an input of no more than 50 millivolts.

"Hallmarked Equipment"

From the point of view of amplifiers, one of the most important moves in Britain has been the introduction of a scheme which will result in manufacturers being able to "hallmark" their equipment so that customers can be certain that performance claims have been checked by an independent test laboratory.

This has been organised by the Audio Manufacturers' Group (6) and all amplifiers that have undergone the required test will carry the "AMG" insignia. The "test-tag" will itself indicate no specific performance for the amplifier, but it will be a guarantee that the validity of a manufacturer's claims have been confirmed.

Rigid rules have been drawn up, specifying the minimum number of performance parameters that a manufacturer must present and which must be confirmed by the independent tests. He cannot, for instance, present only figures for rated output and frequency response. The sensitivity of an amplifier must be quoted (and confirmed) and the harmonic distortion percentage given. The hum and noise factor is another essential aspect.

Mr. S. E. Allchurch, secretary of the Audio Manufacturers' Group, says of the scheme: "Purchasers of high-quality amplifiers rarely have the necessary equipment or experience to carry out the elaborate tests needed to check the manufacturers' performance claims."

Better Tape Recorders

The increasing interest in tape recording, and the call for the highest possible quality both in results and in the mechanics of tape decks, has been met by the production of a number of extremely attractive pieces of apparatus, varying from the highest class of professional equipment to the ultra-simple and much less costly tape recorders which are used for home amusement only. Possibly the most interesting tape equipment comes between these two extremes: the recorders now being produced for the really serious enthusiast.

Notable here is the Mark 5 tape deck made by Brennell Engineering of London (7), used both by the "hi-fi" enthusiast and professional engineers. It employs a particularly accurate synchronous motor to drive the tape capstan, overcoming the irregularities of tape movement that can result in "wow" and "flutter" on the recording. This motor, of the hysteresis type, has its revolving component as an outside rotor, giving the advantages of a steadying fly-wheel effect which enables the manufacturers to claim a "wow" and "flutter" percentage lower than 5.05 per cent at a tape speed of 15 inches (38 centimetres) per second.

Truvox (8) has also produced a new high-quality tape deck which is already achieving satisfactory overseas sales. This, again, is in the quality bracket that makes it suitable for professional use and, in fact, Truvox produces a special professional model in both stereo and monaurol form.

Transportable Tape Outfit

The E.M.I. company (9), which builds and equips radio and television stations all over the world, announced a new professional transportable tape recorder which is already being used in a quite unusual variety of jobs. One application is the obvious one of recording studio and concert hall performances, but the same type of equipment is being used for studying problems of industrial noise, recording transient phenomena in the measurement of brain pulses and as an educational instrument in language instructions. The recorder is particularly rugged and was initially designed for military purposes.

A major export from the British electronics industry is in the form of gramophone record playing decks. There is an international demand for instruments of

Please turn to page 40

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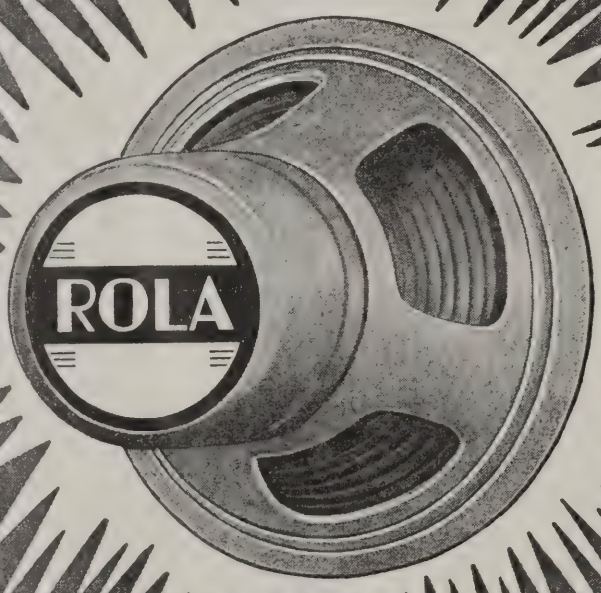

The Rola Company, steadily expanding in the vital field of electronics, now produces Rolatape, a recording tape of the same always-dependable quality as every Rola product.

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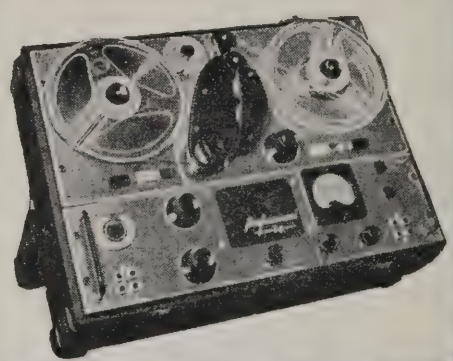

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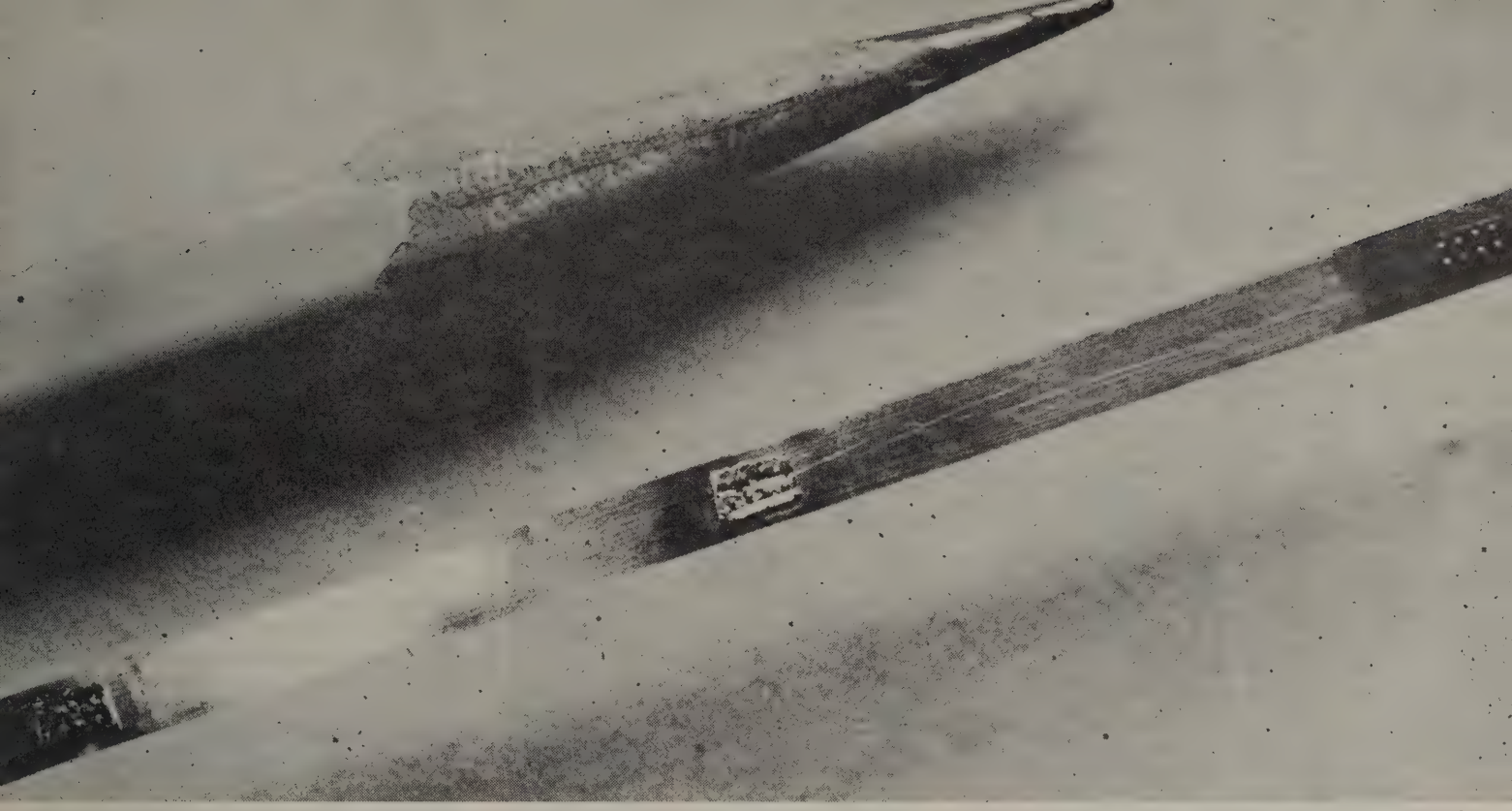


Fig. 3

Recent Advances in Solid State Electronics

C. W. Salmon

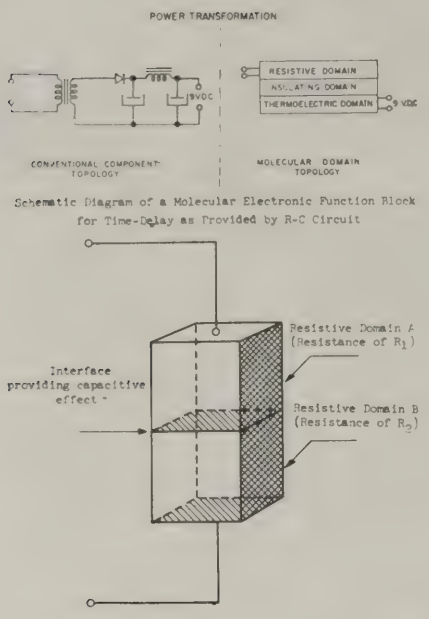
In the design of Electronic Equipment, whether for domestic, commercial or military use, space and weight are vital problems and to a lesser degree the problem of heat dissipation can be difficult. When electronic equipment is used in mobile equipment, vibration can cause termination difficulties, not only with the seating of valves in holders, but also the vibration of components and their leads could cause fractures. In V.H.F. radio telephone equipment built during the late 1940s, many manufacturers met difficulties in securing sufficient rigidity in the small coils required at those frequencies particularly as many of them were self-supported. The author has met cases where the resonant characteristics of a coil have changed because the inter-turn spacing was varying due to vibration.

The advent of transistors has meant a marked reduction in space, weight and heat problems and to some extent termination. More particularly the use of transistors has lessened the weight of otherwise conventional equipment by removing the need for a high tension power supply. Present day developments in high power, high frequency transistors, are lessening the need for bulky power supplies for mobile transmitters.

Despite these marked improvements much still depends on the effectiveness of terminations which, in most cases, are made either by soldered joints or plug-in connections. For instance, in an under water repeater, such as used on the Compac Cable, 300 components result in 1500 individual connections.

The overall reliability of a system is the result of the reliability of each individual item so that if we have a sub unit of three components, each 90% reliable then the overall reliability is approxmately 73%, that is 90% cubed. If there were four components having 90% reliability then the overall reliability would be in the order of 65% and so on. Thus it will be seen that the greater the number of components obviously the less reliable the system will be. In practice this is not true but it is nevertheless, statistically applicable.

Obviously, two ways are available to attack the problem of reliability in electronic equipment; either reduce the number of components or increase their reliability, and this article deals with one of the newer methods of reducing component numbers. The solution of increasing individual reliability introduces cost problems as much as technical ones. In the example given above of three components of 90% reliability, if these were now to have 95% reliability the overall reliability becomes 85% If the same three components are now improved to have a reliability factor of 97.5% the overall factor is still only 92.7%. It will be seen that to achieve an overall reliability approaching 100% the individual component reliability must itself nearly approach that. These figures are very simple because only three components are involved. When it is considered that a modern American heavy bomber has 100,000 components compared to a wartime B17 having only 2000 it will be seen how difficult it is to


POWER TRANSFORMATION
RESISTIVE DOMAIN
INSULATING DOMAIN
THERMOELECTRIC DOMAIN
9VDC
9 VDC
CONVENTIONAL COMPONENT TOPOLOGY
MOLECULAR DOMAIN TOPOLOGY
Schematic Diagram of a Molecular Electronic Function Block for Time-Delay as Provided by R-C Circuit
Resistive Domain A (Resistance of R1)
Interface providing capacitive effect
Resistive Domain B (Resistance of R2)

achieve a system reliability approaching 100% with a large number of components involved. One American author estimated that to increase reliability from 89% to 99% increased the cost 10 times, and to increase from 99% to 99.5% may increase the cost by as much as 50 times. These figures are purely statistical estimation but are in line with the price charged for long life components such as "Ruggedized" valves.

Current Approaches:

There are three avenues available to reduce weight and size and to increase reliability.

1. Micro components.
2. Wafer Assembly.
3. Molecular electronics—functional blocks.

Micro Components:

This is an extension of conventional components with the emphasis on size reduction. Generally the components are made of conventional materials; such manufacture is relatively easy because of the wide background of previous knowledge. Micro components have a definite advantage in size and weight but soldered connections are still required. In fact, the fine wired connections could give great difficulty unless special soldering techniques are used and also the heat transfer from soldering irons could damage the components. Because of this the advantages of reduction in size and weight can be negated by the increased cost of labour owing to the special techniques required.

Dimensional Miniaturisation:

This covers the forming of elements directly onto wafers or substrata such as ceramic by depositing techniques, such as evaporation. Capacitors and resistors can easily be formed together with inter-connections. Even R.F. transformer coils can be formed on the flat and by suitable dispositions primary and secondary coupling can be achieved. This can be done in two ways, either by arranging the coupling on one side of the wafer or by employing the other face of the wafer for the winding. This is really only an extension of printed circuits except that much more stable material can be used and of course, ceramic material can be chosen to have the exact characteristics required. By such means many inter-connections can be avoided and bulky components can be greatly reduced in at least two dimensions. However, connections still have to be made to valves or transistors.

Functional Blocks:

Basically, the functional block is a single physical entity having the electrical characteristics of a particular circuit or circuit section. It is **not** a collection of individual components made up in a packet but a **single** component having the characteristics of a group of conventional components.

As all materials exhibit resistive and capacitive characteristics in varying degrees, space saving subsystems can be built up by fabricating an items such as a filter network, by stacking wafers in the required configuration. However, there would be definite and distinct physical boundaries in such cases and manufacturing difficulties would be introduced.

On the other hand, the behaviour changes found in such materials as Germanium and Silicon when subject to chemical treatment, magnetic fields, radioactive radiation, mechanical pressure, temperature and voltage are so explicit and calculable that the required inter-faces to give the different waferlike characteristics are attainable under controlled production. The required effects are created in the material as distinct domains by etching, plating, alloying, cutting, masking, deposition and similar standard techniques although each domain exhibits the required characteristic, the whole block, perhaps of 3, 4, 5, or 6 domains is a single entity. The domains border one another at boundaries or interfaces, which are like political frontiers in their ability to initiate phenomena different from those occurring inside the molecular domains.

As a simple example in the element diagrammed in Figure 1 we see that it is composed of two domains which meet physically at one interface. One of these domains is composed of a resistive material selected and shaped to present a resistance R1 to the passage of current; the other domain is also resistive, but is so planned that it has a resistance R2. At the interface, the interaction between domains causes a capacitive effect. Thus, in one small element there is a subsystem equivalent to a time-delay circuit.

Another illustration of the uses of domains and interfaces is a function block designed as an ac-to-dc power supply for transistor circuits. It makes use of the Seebeck effect for the thermoelectric generation of electricity to convert alternating current to direct current power. In contrast, the conventional circuit, Figure 2, requires five individual components—a transformer, a diode, and the inductive and capacitive elements making up the LC filter circuit. To accomplish this same purpose with molecular electronic methods a function block comprises the three separate domains. When a-c power is applied to the resistive domain, the heat that is generated passes through the domain at the centre—this domain is an electrical but not a thermal insulator—and into the thermoelectric domain where the energy is converted into electrical energy by the Seebeck effect. Proper con-

trol over the materials used, provides the 9-volt d-c output desired. An interesting aspect of the power supply is that elimination of ripple as an undesirable variation in voltage is inherent since heat flows from the resistive domain to the thermoelectric domain at practically a constant rate.

As these two examples suggest, the concept of molecular electronic makes no use of the traditional circuit — and — component approach to electronic. Instead, the objective is to use knowledge of the structure of matter to synthesize monolithic function blocks whose arrangements and composition permit each to serve as substation to perform an electronic function in the control or transformation of energy.

To achieve function blocks with this capability, a number of effects and phenomena of the solid state are available. The only firm limitations on choice are that the effect must not react adversely on system reliability and must lend itself to consistent results when included in a function block. Methods typical of practice so far include: solidstate phenomena, such as Seebeck generation, Peltier cooling and Hall effect multiplication; the use of PN semiconductor junctions arranged to produce a result which would otherwise require numerous individual components ;and when necessary, fabrication of circuit elements within a function block. Athough such phenomenon will be most often used for the control of electrical signals, they will also be suitable when quantities like electromagnetic radiation, heat, and mechanical displacement are inputs or outputs.

The degree of a subsystem begins with the designer's analysis of the requirements of the system, to establish the functions to be performed by the function block. After the processes are determined and suitable physical effects settled upon, a topologist—a mathematician who works with shapes determines the structure of the block by designing, on paper, the arrangement of domains and interfaces that is to control the flow of energy in the block. The block is then produced by materials engineers who use Germanium and Silicon as the basic semiconductor materials.

In producing these blocks they are not assembled from various tiny components. Rather, a start is made with a basic semiconductor wafer and the necessary domains and interfaces are produced by techniques used in the production of conventional semiconductor devices, including diffusion, plating, electron beam machining, etching, cutting, radiation, alloying, and photographic processes. Although the function block so produced can now perform its function, additional processing steps are required to encapsulate the block, protect it against shock and vibration, and make it stable under the conditions of temperature and radiation it will encounter.

As has been observed, the dominant theme, the essential philosophy of molecular electronics is that one can now create, modify, and process materials to endow them with the ability to accomplish electronic tasks through solid-state phenomena. The foundation of success has been the ability to develop new materials and to process available materials in new ways.

One important illustration of the contributions made by materials scientists is the development of a method for the rapid production of semiconductor crystals in a form that requires no removal of material to make them into suitable wafers for use as transistors or as the basic elements of molecular electronic elements. This is the dendrite process announced several months ago, in which germanium crystals in the form of ribbons about one-eighth of an inch wide and a few thousandths of an inch thick, are produced by drawing them from a molten mass. In contrast, in the conventional method, germanium crystals are grown as thick ingots, or boules, which require X-ray or crystallographic inspection before they can be sawn into precisely oriented wafers and then must be lapped, etched, and polished to obtain a satisfactory working surface. In addition to the waste of material and the cost of machining involved in the standard method, a serious disadvantage to its use for the production of molecular electronic blocks is the wide variation in characteristics frequently displayed by wafers, even by those cut from adjacent regions of a single ingot and processed identically. In the production of transistors, this difficulty can be circumvented by testing a production run to select those with proper values. In molecular electronics, however, it is necessary to build junctions in adjacent portions of the same crystal; thus it is essential to have materials whose characteristics are uniform if the yield is to be acceptable.

Other advantages of this dentritic method of importance to molecular electronics are these:

It is essentially a continuous process in which the germanium ribbon grows at a rate of 6 to 12 inches per minute and in the precise direction of crystal growth we require for application. Thus, no X-ray or crystallographic examination is necessary, and the surfaces of the ribbon are always correctly oriented, optically flat, and immediately usable as working surfaces. An additional advantage is that if a contaminant enters the melt during the process, the resulting inclusion is "self-healing" so that when the process is completed the affected portion can be cut away and the unaffected portion put to use.

Now, although this dentritic method has immediate usefulness in molecular electronics today, its importance is that its greatest significance is its ability to bring about a number of completely new processes for producing functional blocks. Interest has been aroused in a recent modification which makes it possible and practical to carry out diffusion, plating, and evaporation processes directly on the crystal as it grows from the furnace melt. With this technique, one is able to create semiconductor devices ready for the attachment of leads. One of the first uses has been to grow transis-

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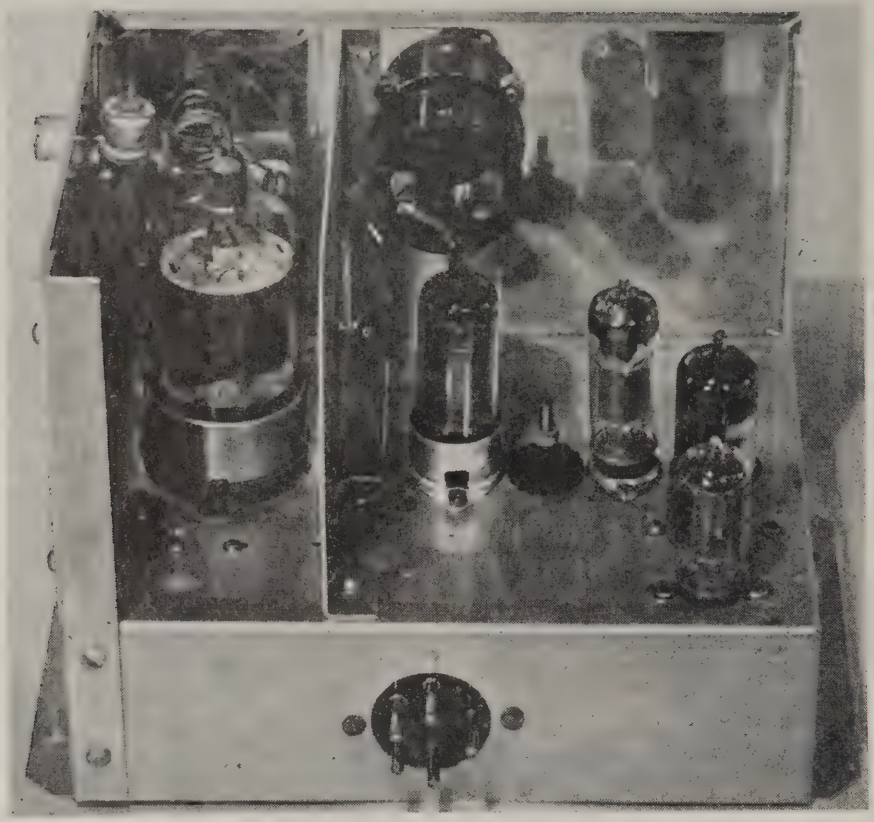


FOR THE AMATEUR—

A Medium Powered 2 Metre Transmitter

Irving Spackman, ZLIMO

One of the problems facing any amateur interested in building a medium powered transmitter for the very high frequency bands such as two metres is the choice of the tube for the final class C stage. There are a number of older ex war surplus tubes such as the 815, 832A and 829B which operate successfully at such frequencies and with reasonable efficiency at inputs in the neighbourhood of 50 watts. However, most of these are now nearly 20 years old and very few have survived. Their modern counterparts such as the QQE06/40 and QQVO3/20 are rather expensive and consequently are not favoured on this score, although their characteristics, efficiency and performance cannot at present be surpassed. Smaller tubes such as the modern 2E26 and QQEO3/12 are available but not capable of inputs better than 20 watts which although entirely satisfactory for local use, are not quite sufficient for more serious long distance work, over 100 miles or more.

With these thoughts in mind, the author decided to try the commonly used and often difficult to tame, 6146. This tube is designed to operate with full ratings to 60 megacycles and is capable of operating on reduced ratings up to 175 megacycles.

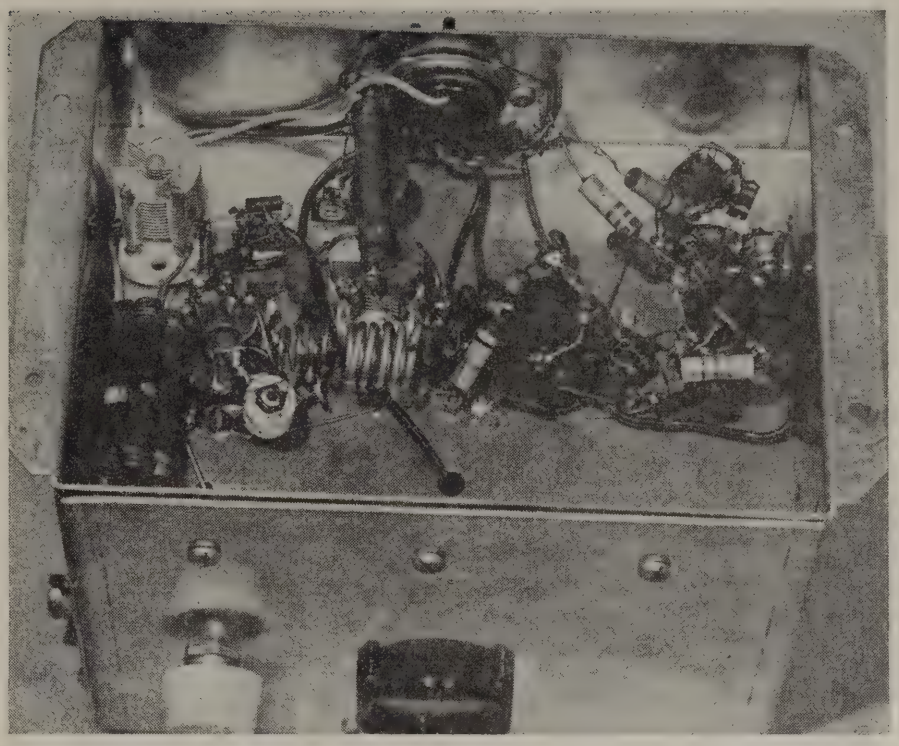
One of the difficulties often encountered in V.H.F. transmitters is the provision of adequate driving voltage for the final tube. There are nearly as many pet designs for V.H.F. drives and exciter systems as there are V.H.F. enthusiasts and this one shown in the circuits here is no exception. Generally when one finds a suitable system it is advisable to stick to it, as it is usually developed through experience and cut and tried over quite a long period. There have been a number of tubes designed for efficient multiplier and driver service. One of these is the 5763 or QEO3/10. This is used here by the author as a doubler-driver from 72 megacycles to 144 megacycles, and is capable of providing adequate drive for a final tube such as the 6146 or QQEO6/40, provided it itself is driven satisfactorily. This means

that for efficient multiplication the tube should have at least 75 to 100 volts of RF drive. This voltage is fairly readily available at a frequency of 72 megacycles. Although tubes such as the 5763 are excellent for such a position they are uneconomical in such service, mainly because of their high filament and plate current consumption. Two tubes which the writer has found can economically and efficiently produce sufficient drive for a tube such as a 5763 up to frequencies of 75 megacycles are the older EL42 and the more modern EL95. These tubes can provide adequate RF power output with a filament consumption of 6.3v at .2 amp or so and H.T. requirements of 20 to 25 milliamperes at up to 300 volts. Both these tubes have quite low input, output, and interelectrode capacities and sufficient mutual conductance to give good multiplication efficiency at high frequencies. The tubes are also physically small which aids compact designs—a major requirement for efficient VHF design.

Turning now to the circuit and some of the more general details.

The crystal oscillator uses a 12 megacycle crystal and triples the frequency to 36 megacycles. The second tube, also an EL95 doubles the 36 megacycle energy to 72 megacycles, whilst a 5763 operating with a series tuned plate tank circuit doubles to 144 megacycles. The 6146 operates with inputs of up to 55 watts, which is the maximum permitted by the manufacturers under amplitude modulated service at this frequency. Both grid and plate circuits are series tuned tank circuits for maximum efficiency. The screen circuit is series tuned also to "neutralise" the "feed through" of energy from plate to grid. This effectively stabilises the tube against regenerative effects and instability.

The author has also utilised the existing driver section in another way starting with an 8.0 megacycle crystal. The first tube has been used as an oscillator tripler to 24 megacycles. This has produced sufficient output to drive the second EL95 as a tripler stage to 72 megacycles. This will give sufficient drive to the 5763 to enable it to double efficiently to 144 megacycles. Either of these two driver systems can be used confidently with no other alteration to the circuit than the first coil in the plate of the oscillator, and in some cases will be determined by the availability of crystals, and the location and frequency of local T.V. stations. This point will be dealt with later in the article under T.V. Interference.



Technical Details

It will be noticed that the coils in the initial stages of the transmitter do not use tuning condensers. They are in fact resonant with the capacities present in the tubes, sockets, and the strays which must be present in any circuit. These coils are slug-tuned to resonance, and give good performance. The coil in the plate circuit of the 5763 is series-tuned, as are the others in the remainder of the transmitter. It could be just as well at this juncture to explain series tuned circuits as their appearance may be a little mysterious to some of our readers.

A series tuned circuit is in fact a tuned circuit tuned by a balanced split stator condenser. This is brought about by considering the output capacity of the tube (the capacity "anode to earth" as shown in most tube manuals) plus the capacity present in the socket, plus the stray capacity to earth of the lead from the socket to the beginning of the coil, all in parallel as one half of the split stator unit, whilst the series tuning condenser capacity plus the capacity of the lead to this condenser to earth, plus the stray capacity of the condenser to its mounting, as the other half of the stator capacity. We generally try to achieve a relatively balanced configuration of the two sides of this split stator by designing the coil to resonate at the right frequency under such a condition.

As can be realised such a design of a tuned circuit enables us to make effective use of the output capacity of the tube and retain a usable and workable amount of inductance in our coil which would not be the case if we placed both the tuning condenser and the output capacity of the tube and socket, etc., in parallel. This fact is even more obvious when we look at the input capacity of a 6146 which at 13 pf, plus the socket and stray capacities amounting to say 5 to 7 pf gives

a total capacity of about 20 pf. This would mean that we should only be able to get one or two small turns in our coil at the most —this would be very inefficient both from the point of view of coupling and operating efficiency.

We mentioned before that we try to achieve a balanced configuration with regard to the capacities in our split stator effect tuning condenser. However, it is very unlikely that we will get an exact balance. The capacities of the split stator combination also give an effective earth point for the coil but this must also be a little flexible in position. Accordingly we feed our D.C. supply into the coil near the electrical earth point on the coil, but we feed it into the circuit through an R.F. choke so that any error in locating the "virtual" earth position will not be troublesome by giving multiple earth effects in the tuning circuit which can give rise to many problems. This process is used both in the 5763 anode and the 6146 anode circuits. To avoid the problem of parasitic oscillations in the 6146 we use the grid leak resistor as an RF stopper resistor in the centre of the grid circuit series tuned coil.

Another detail in the circuit which may look strange to some of our readers is the series tuned screen circuit used in the 6146. Here we have a small value of variable capacity connected to ground rather than the larger value of fixed capacity connected from screen to ground—a design figure which we have been accustomed to find in the equipment designed for lower frequency use.

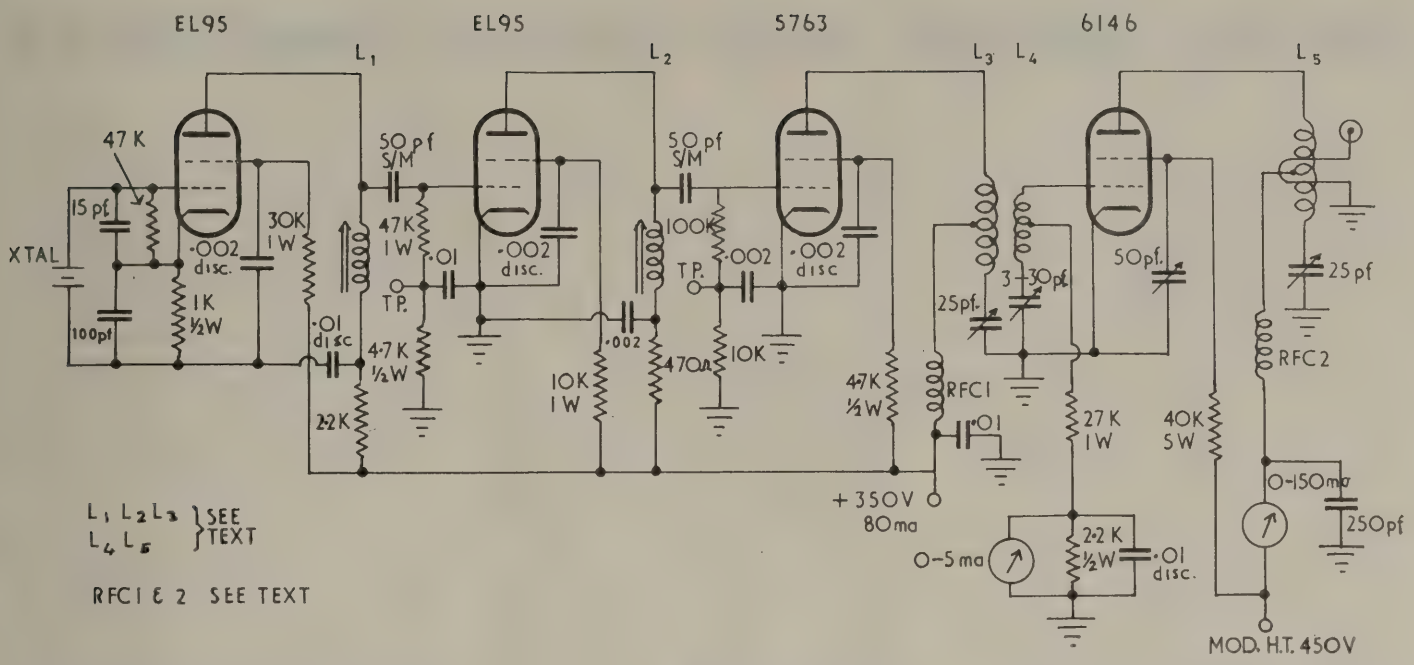
At low frequencies the main cause of feedback from the anode to grid circuit via the tube itself is the anode to grid capacity. Generally speaking this has been reduced in the modern beam tetrodes and pentodes to a point where neutralisation is not required. This is because the screen, suppressor and beam forming plates have served to shield the grid from the plate, provided the screen has been adequately and correctly by-passed for RF at the tube socket. As the frequency is raised, the lead connecting the screen to the base pin(s) becomes longer, constitutes a greater amount of inductance, and the screen by-pass condenser becomes less effective, so that the screen permits some energy to feed through between grid and anode. At one particular frequency, called the self-neutralising frequency the amount of energy fed via the screen, cancels the energy fed back via the anode to grid capacity and the tube becomes neutralised. With the 6146 this frequency is in the region 90 to 110 megacycles. Above this frequency the energy coupled through from grid to anode via the screen is sufficient to make the tube regenerative, unstable and it will often oscillate on its own. In fact the tube is over-neutralised. Attempts to tame the tube with the usual methods of neutralisation employed in low frequency equipment usually make matters worse. There are two accepted methods for effecting a cure. One is to feed additional energy from grid to plate to cancel that being fed through via the "hot" screen. This is done by connecting a wire to the grid circuit and bringing it near the plate circuit in such a manner as to increase the feeding back of energy directly from grid to plate—the reverse of low frequency procedures, and a trick which mystifies many of the low frequency operators. The second method is to series tune the screen circuit to ground. A series tuned circuit acts as a low impedance to any signal at the frequency to which it is tuned. In this case it is the inductance of the screen lead inside the tube itself which is series resonated to ground thus presenting a low impedance to any energy at that frequency which appears on the screen grid. Thus the tube operation reverts back to normal. However, both these methods are frequency sensitive and will not operate if the equipment has to operate over a wide frequency range.

A point which was raised earlier in the article was Television Interference. The output circuits of this transmitter being tuned to a frequency of 144 megacycles, discriminate very well against energy falling in the television channels. They are in fact an effective short circuit on all frequencies in the region of Band 1 TV signals. However, it is often expedient to choose multiplication frequencies which do not fall in the local TV channels. The second multiplication frequency of 72 megacycles is one such frequency, whilst 36 megacycles falls in the IF range of New Zealand-built receivers. Whilst 24 megacycles does not fall into any TV channel, the second harmonic of this—48 megacycles does fall into Channel 1. However it must be stated that this transmitter has been operating for over a year into a high gain directive antenna in, until recently, a fringe area for Channel 2 and not one case of TVI from it has been reported.

This transmitter is constructed on an aluminium chassis 7 inches long, 5 inches wide and two inches deep. The front panel of 18 gauge aluminium sheet is 9 inches wide and 5½ inches high. The meter on the front panel is a small 1½ inch 5mA movement reading grid current to the final stage whilst the knob to the right of the meter tunes the final tank condenser. The remaining coil slugs and variable condensers are pre-set and rarely need touching as the equipment is virtually fixed tuned in frequency—slight excursions of up to half a megacycle obtained by changing crystals are easily carried out with no retuning required.

The 6146 is located within its own compartment being completely shielded from the other tubes. This compartment is 2½ inches wide and extends above chassis from front to rear.

Although very compact for maximum efficiency the underside of the chassis is not cramped. In every case the layout of the coils and sockets has been primarily for the end result to be, the shortest possible leads. The anode coil of the 5763 and the grid coil of the 6146 can be seen mounted end to end, their leads finishing either on their respective tube socket pin, or their respective tuning condenser.



All the cathode pins of the 6146 socket are banded together with 16 gauge tinned copper wire and also bonded directly to chassis as well. There are in fact 5 earth connections from the octal socket direct to the chassis. The lead from the screen pin to the series tuning condenser is also only an inch of 16 gauge tinned copper, whilst the screen dropping resistor is also mounted right on the screen pin.

There have been a number of various circuits tried in this chassis and this fact accounts for some of the obvious alterations which have been made.

Coil Table.

L1 6 Turns 22 gauge enamelled on ½-inch slug tuned former for 36 megacycles. This can be increased to 8 turns for 24 megacycle coil. Both these coils are close wound.

L2 3 Turns 22 gauge enamelled on ½-inch slug tuned former close wound. This coil tunes to 72 megacycles.

L3 5 Turns 16 gauge tinned copper ½-inch diameter, ¾-inch long self supporting. The RFC 1 is connected to second turn from the 5763 plate end.

L4 4 Turns 18 gauge tinned copper ⅜-inch diameter, ½-inch long self - supporting. The 27k 1 watt grid resistor is tapped 2 turns from the grid end.

L5 4½ Turns 16 gauge tinned copper ½-inch diameter, ¾-inch long, self - supporting one end mounted directly on plate cap clip for 6146. Other end mounted directly on tuning condenser.

L6 Link Coil 1 Turn 10/010 hook-up wire inside fibre - glass spaghetti insulation ⅜-inch diameter mounted half into gap between 2nd and 3rd turn. One end mounted directly on coaxial socket, other end returned to fixed plate of Philips 3-30 pf air trimmer.

The 2 R.F. chokes can be made by taking a high value 1 watt composition resistor and winding it fully from end to end with 30 gauge enamelled copper wire.

One good construction tip which should be observed is, with the exception of the octal socket for the 6146 which we have dealt with, all other sockets should utilise single point earths, that is, return all earth returns to the one solder lug, mounted under one of the socket retaining screws. It is imperative that the earth sides of all variable condensers are always returned also to this point using the thickest and best conductor such as 16 gauge copper wire or braid if possible. It also pays to run a similar conductor between sockets. This will ensure stable conditions and best efficiency.

Tuning Up the Transmitter

Tuning of the coils, particularly in the exciter portion is best initially carried out with a grid dip oscillator if this can be obtained. Otherwise a certain amount of cut and try experimenting may be necessary, due to slight changes in layout, etc. However, there is a fairly large amount of latitude allowed both in the slugs and the variable condensers. It is suggested that the exciter portion only be tackled first with the 6146 in place, with filaments alight but with no HT applied to anode or screen.

Please turn to p. 24.

Some Simple ←Stereo→ Amplifiers

One of the problems facing many of the present day high-fidelity enthusiasts is the conversion of existing monaural high-fidelity equipment to reproduce satisfactorily the modern stereophonic recordings. In many cases which have come to our notice, we find that the owners of good monaural equipment, bought or built, a few years ago, are faced with the following problem.

The existing loudspeaker enclosure is of largish dimensions and giving excellent reproduction. However, there is no spare room in the more modern house for the extra enclosure of similar performance to make the stereo "twin." A second problem; the owner of a good quality amplifier of from 10 to 30 watts output, either purchased or built from designs in this and other magazines, has built it into an existing cabinet along with a turntable and perhaps a tuner. However, neither the control unit, nor the amplifier, even in some cases the pickup arm itself, is suitable for modification to stereo, except at great expense.

These two problems probably by now will have given our readers some inkling of the trend of this and following articles—what is the easiest approach for a person in the position of either of the hypothetical people described above.

We will examine these problems in several various ways.

First, one method—one doubtlessly rejected by a great number of our readers for one of many reasons, is to discard all the existing monaural equipment and buy or build new stereo equipment. This is not really a practical approach for most of us. A second method is to utilise the existing turntable and pick-up combination, provided that it is suitably wired for stereo, build or buy two new matching speaker enclosures and a new stereo amplifier. This also will not gain many supporters, if only for the reason that it is still a very expensive way to attain stereo. A third method,—use the existing speaker enclosure together with a smaller and more compact companion "twin," and build or buy a new stereo amplifier. Particularly if a certain amount of tolerance is exhibited, whilst initially considering the concept, the position now becomes more attractive.

Here are some of the reasons.

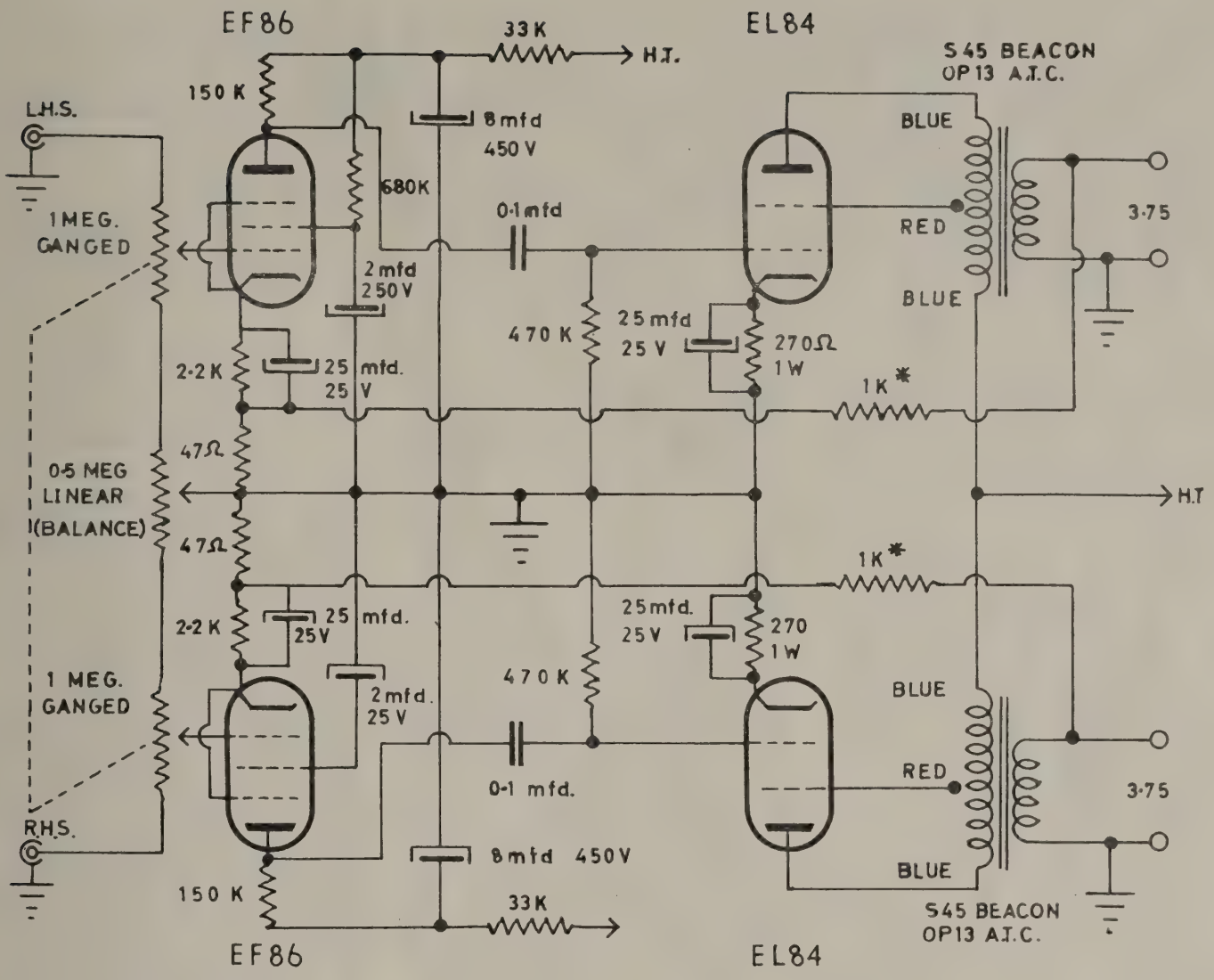
Whilst it is undoubtedly desirable to have high quality and excellent performance loudspeaker enclosures in both channels of the stereo system, it has been demonstrated both overseas and in this country, that tolerably good stereo performance can be achieved by using one top performance speaker enclosure and a "twin" of lesser capability. The stereophonic effect appears to have the same realism whilst the wide range reproduction from the one channel tends to fill in the gaps left by the less efficient "twin" with the poorer response. This doesn't mean that any old speaker conjured into an old crate will give good stereo—far from it. However, a 2 cubic foot enclosure with an 8-inch woofer and a companion tweeter, properly matched, preferably with a crossover network will give a good account of itself when used as the stereo "twin" for the "big brother." Such an enclosure also can be included in most households without extensive alterations or disposing of furniture. The main requirement is separation of the speaker systems. Good stereo cannot be reproduced if both speaker systems are not separated by at least 6 feet, or more, if possible.

Now, having dealt with—at least temporarily, the problem of the speaker enclosures let us take another look at the amplifier position.

Whilst it is fully recognised that a person who has been listening to say a 20 watt amplifier allegedly capable of producing audio with no more than .1% harmonic distortion, has become used to good quality reproduction, and may not put up with anything inferior, there are certain compensations available from stereophonic reproduction which help to alleviate some of the tendencies to refuse to consider other types of equipment. Some of these effects which are most noticeable are the sense of realism, and depth, which stereo reproduction gives, whilst the greater illusion of echo and reverberation, coupled with movement of the musical subject tend to gloss over, at least initially, the fact that the distortion might be 1% or the transient response might not be quite so good . . . and so on.

It is with these thoughts in mind that we have suggested that where it is not practical or economical to duplicate the existing monaural amplifier and control facilities, a smaller single unit stereo amplifier be built to cater for the stereophonic reproduction. It must also be remembered that where the monaural system had to do all the work, each amplifier in the stereo system has only to cope with half the total sound energy produced. It is also commonly acknowledged that the sound coming from several directions at once gives the impression of greater loudness than the same sound level coming from the one source.

With this preamble we are going to set out to describe a number of simple stereo amplifiers which our readers may like to build so that they can try out this stereo business without a great deal of expense. In the next article we will describe a dual ten watt stereo amplifier and also a simple but attractive 2 cubic foot enclosure suitable for use as an extra "slave" for the existing enclosure, or as "twins" for a new system.



* CHANGE TO 2·2K IF 15Ω OUTPUT IS USED
ALL RESISTORS ARE ½ WATT 10% EXCEPT WHERE SHOWN

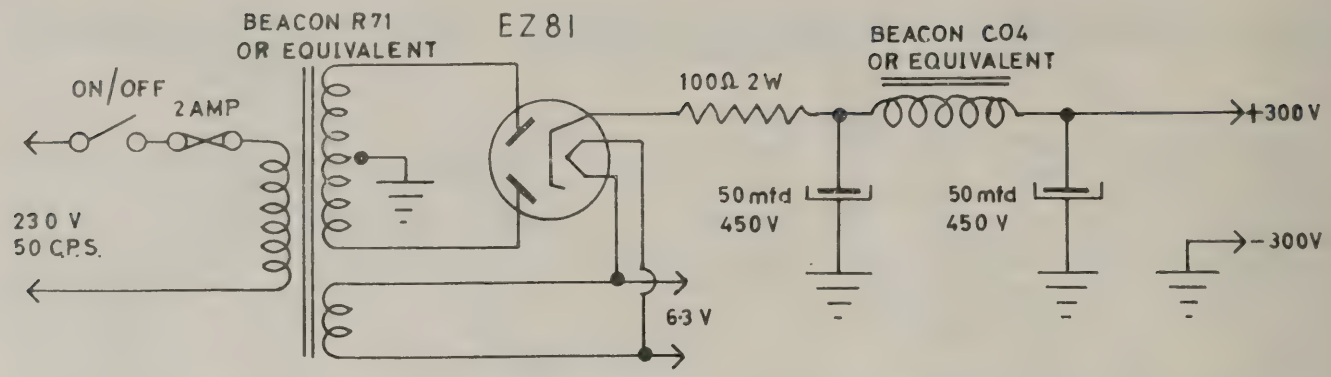
It will be noticed by reference to the circuit diagrams accompanying this article that in the case of the two amplifiers shown both draw something less than 100 milliamperes total from the HT and about 2 amperes at 6.3v for the filament. This means that, if desired, provision can be made in just about any of the more common monaural amplifiers in use throughout the country to derive the power for the stereo unit from the existing monaural amplifier. This generally means including a socket on the chassis of the main amplifier with a suitable plug and cable to lead out the HT and filaments to the stereo unit. This socket can have the filaments and HT supply for the monaural systems also wired through the socket so that a separate "dummy" plug with jumper wires included can be used to restore the monaural system to operation if desired.

This extension of power supply facilities means that a considerable saving in cost of the new amplifier can be achieved. Do not, however, be tempted to try to take power for one of these amplifiers, from an existing radio tuner or other such accessory socket, as there is only a very remote chance that such an outlet will be capable of supplying the necessary voltages at sufficient current.

If such a system modification is either not practical or is not acceptable then there is no alternative but to include a power supply as part of the equipment.

We have shown two circuits of relatively simple and inexpensive power supplies for these amplifiers. Both of these are capable of delivering all the current and voltages required by either of these two amplifiers.

The first power supply shown uses a standard transformer available from any of the firms which advertise in this magazine. Using an indirectly heated rectifier, this enables the single heater winding to cope with both the rectifier and audio amplifier filaments. If a different transformer



is used, and it has a 5 volt winding as well, a cathode/heater type rectifier such as the 5V4G or GZ32, which have 5v heaters, can be used instead of the type shown on the circuit.

With regard to the second power supply—the one using silicon diodes—these have a great deal to recommend them, particularly if all the equipment is built on to one chassis. The silicon rectifiers score as regards regulation efficiency, lack of heat produced, due to their very high efficiency and small size. However, to date, perusal of various transformer manufacturers' catalogues has not led to our being able to locate a suitable transformer. Consequently we made representation to Beacon Radio Ltd. who produced us a sample transformer to do this job. The sample gave us the following specifications with 230v. A.C. applied, and used in the silicon rectifier full-wave voltage doubler circuit. H.T. output from filter 240 to 250 v. at 30 mA, L.T. 6.3 v. at 3.0 amps.

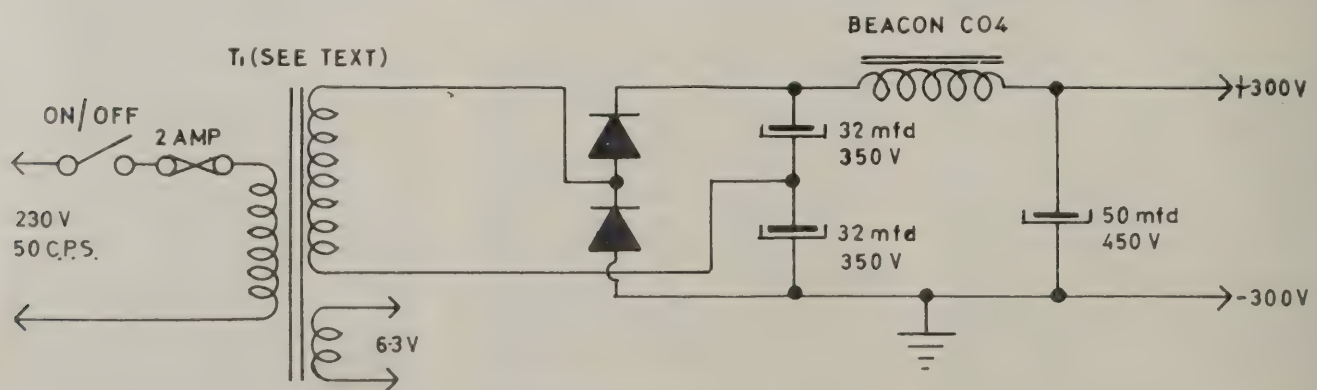
Our sample was numbered 23219, and we understand that it will be available at a very reasonable price, initially, against order, by quoting this number, but ultimately will be given a catalogue number of its own.

The first amplifier is a very simple affair. Each channel uses only two tubes, an EF86 and an EL84, operating in a semi-distributed load condition. This tends to help lower distortion, and yet gives far more output than if the amplifier was operating in the triode connected condition. Whereas most designs of push pull ultralinear amplifiers use either a 20% or a 43% tapping on the output transformer, by utilising a standard 6 watt push pull output transformer, and using the centre tap to feed the screen, we get a 50% tap as far as turns are concerned, but a 25% tap as far as impedance is concerned. With a small amount of negative feedback over both stages, the sensitivity for an output in excess of 3 watts is such that the amplifier is easily driven from virtually all makes of stereo crystal cartridges. The frequency response is excellent, considering the simplicity of the amplifier and the harmonic distortion at full output is not high.

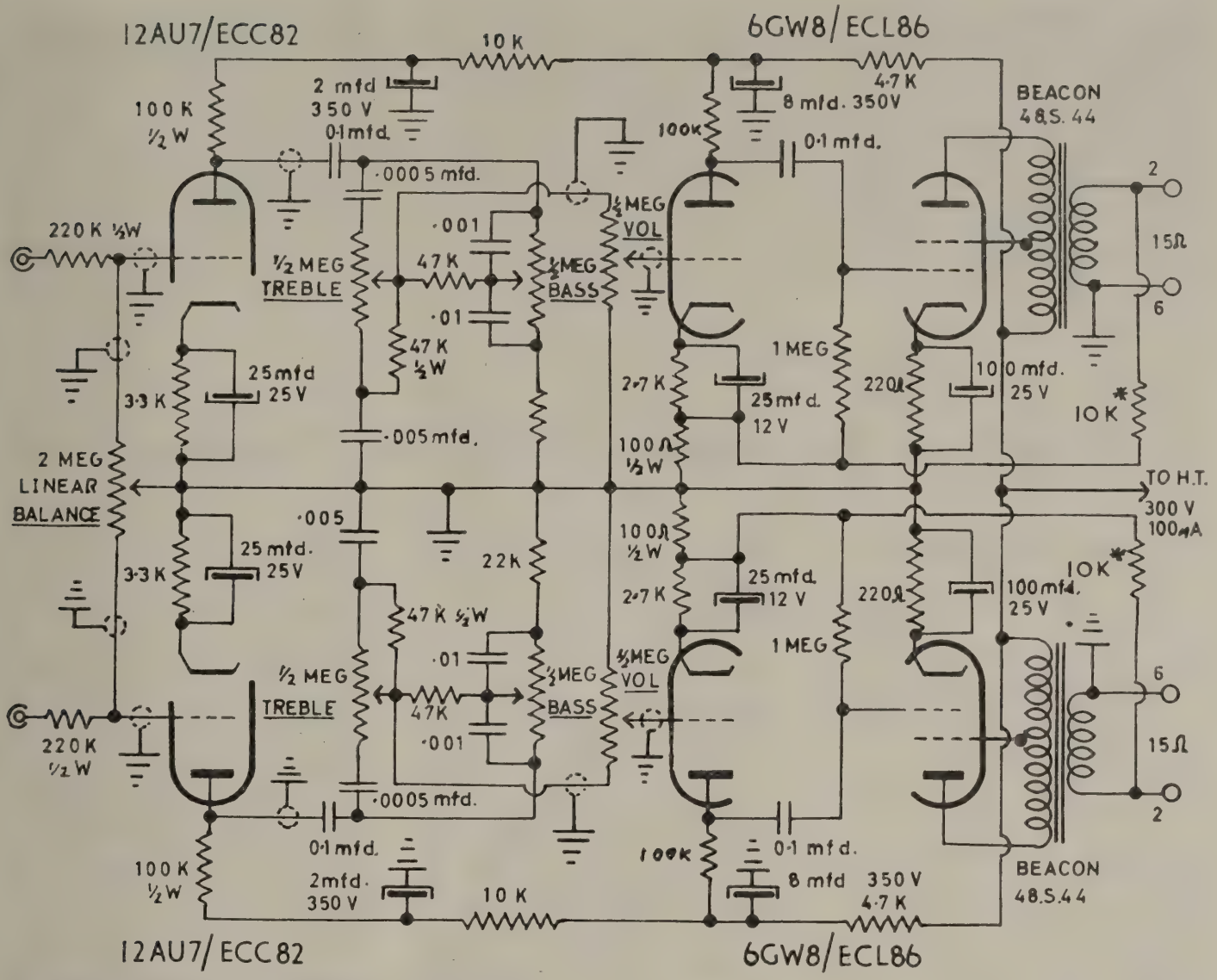
We have not shown any tone controls in this circuit. However, the sensitivity is such that a simple tone control can be included if desired and we shall publish a circuit for such a modification next month.

For simplicity and economy we have not included any switching facilities for reversing the channels, or for connecting both channels together to provide monaural operation, as it is assumed that monaural facilities are already available. However, such switching is not complicated, and can be easily added if desired. The stereo balance control is quite adequate, and once set up, rarely needs adjustment. The output damping factor, due to the negative feedback is good.

The second amplifier shown in the accompanying circuit diagram is a little more pretentious version of that previously described. It utilises one of the more recently developed triode output pentodes, within a common envelope, the ECL86 or 6GW8.



DIODES ARE OA210, OR, 1N763, OR EQUIVALENT



The original design of this amplifier used an ECL82 or 6BM8 in the output stage. The ECL86 is superior in performance to the ECL82, giving more output, with slightly lower distortion. The output section again operates in the form of distributed load arrangement, which was discussed earlier in this article.

With the addition of an extra double triode, one half being used for each channel, we have sufficient reserve gain to include a full passive tone control network, a balance control, and also can make provision for pickup compensation if necessary, and provide some equalisation for recording characteristics.

The circuit as shown does not include any switching arrangements for the input circuit, or the last two provisions mentioned in the preceding paragraph. The switching can be easily added if desired, whilst circuits for the other two provisions are included in next month's continuation of this article.

In each case output impedances, to match the speaker system in use, which may have impedances other than those shown in the circuit, can be easily obtained using the chart which accompanies each transformer. The anode load impedance using the distributed loading configuration used in these circuits conforms very closely with the pentode operating conditions quoted in the tube data sheets.

There are no particular precautions to be taken in either of these amplifiers. Methodical layout and the use of twisted heater leads, shielded wire for all high impedance circuits, and good

quality components should enable the reader to produce an amplifier capable of very low hum and noise levels. In each case the amplifier should be completed and checked over before power is applied. Do not wire in the feedback resistor. The power should then be applied and once it is ascertained that the amplifier is operating correctly, the feedback resistor should just be touched into circuit. If all is well the gain of the amplifier will drop, giving improved quality. If, however, the phasing of the feedback is positive rather than negative, the amplifier will oscillate, and it will be necessary to reverse the connections to the secondary winding, that is change the earth and feedback leads to the opposite sides of the speaker connections.

This concludes this part of the article. Next month we shall discuss speaker enclosures, giving details of a practical and easily built unit for the reader, and another amplifier for the enthusiast who wants more power, and slightly better performance than either of these two amplifiers can provide.

END

A Medium Powered 2 Metre Transmitter

Continued from P. 19

Caution—High Voltage—

The following table will give some indication as to the figures expected with a HT supply of 300 available. These are taken using a 12 megacycle crystal with a 20,000 ohm per volt meter.

V1 Cathode	20v
V1 Screen	220v
V1 Anode (H.T. side of coil)	275v
V2 Grid Test Point ..	—6v
V2 Screen	250v
V2 Anode (HT side of coil)	300v
V3 Grid Test Point ..	—8v
V3 Screen	280v
V3 Anode (HT side of choke)	300v
V4 Grid Current (on load) with power on 6146 ..	3mA
V4 Screen	150v
V4 Anode (HT side of RF choke)	500v

Once the exciter has been tuned up so that the 6146 has received the correct excitation voltage on 144 megacycles and there is at least 3 to 4 mA of rectified grid current indicated, the anode circuit should be tuned to resonance, still without power applied to the 6146 plate and screen. It is quite likely that a downward flicker of grid current will be observed when the plate tank circuit is tuned to resonance. Now adjust the screen neutralising condenser from minimum capacity slowly a little at a time whilst observing the effect on the grid current as the anode is being tuned through resonance. (Alteration of the screen condenser will also necessitate retuning the 6146 grid, and probably the 5763 anode circuit, also to maintain maximum grid current). Ultimately a point will be found in the travel of the screen condenser where tuning the plate to resonance does not affect the grid current. When all these various tuned circuits are finally adjusted, then switch off, connect the HT line to anode and screen — CAUTION — HIGH VOLTAGE—and either connect a dummy load or an antenna lead to the coaxial socket. Apply power and quickly tune the plate circuit to resonance indicated by the plate current dip. Adjust the link coupling to secure a maximum anode current of not more than 120 mA when using an anode supply of 500 volts. If a calibrated dummy load or output meter is available at least 35 watts should be measured at the output with an input of 60 watts to the anode—an efficiency of 60% which is quite reasonable at this frequency. This means that the tube is handling close to its maximum rated dissipation for I.C.A.S. operation.

When connected to a good directive antenna system this transmitter will give a good account of itself. Because of the adequate grid drive, the final stage modulates well. Although this little transmitter was not intended for 2 metre use but rather as a driver stage for a 420 megacycle tripler, it has performed so well that it has been kept as the main 2 metre transmitter whilst a much more pretentious and higher power 2 metre transmitter still remains unfinished.

Computers . . . PART TWO

P. L. WATTS
With acknowledgement to R. L. Currie, M.A. (Cantab.)., B.Sc., of International Business Machines.

Review

In our first article we saw that the computer is concerned with processing information. The analogue computer handles quantities by turning them first into other physical quantities, and then processing these new quantities. The digital computer, on the other hand, handles quantities by manipulating their numerical magnitudes. In this article the essential features of the digital computer are described.

The Digital Computer

The digital computer is general in its application. One minute, it may be calculating structure factors in connection with X-ray crystalography, the next, it may be doing some stores accounting procedures. In the case of the larger computer, it may even be performing two or more such procedures simultaneously; it would, in fact, be quite desirable to do so. In the analogue computer, if a certain amplifier performs an integrating function, it is a relatively complicated operation, even if it is possible, to change it to, say, a differentiating circuit. However, it is no problem to replace, for example, the subroutine which is in storage in the digital machine, for finding the sines of angles, with another subroutine which calculates square roots or one for computing "PAYE" tax.

In dialling a telephone number, it is not sufficient to dial the number you want to an accuracy of perhaps plus or minus .1%. You must dial the exact number to obtain the correct connection. In an analagous manner to this, the digital computer is exact. You are either right or you are wrong. A miss is as good as a mile, for a digital computer has exactness inherent in it. A digital computer has the ability to store with complete accuracy and almost immediate accessibility, vast quantities of information. The computer is instructed in precise detail the steps it must take in order to process this information. The processing may include, if required, a vast amount of arithmetic. The result is that all the facts come together as a conclusion. How is the computer organised to accomplish these functions?

An Analogy

The human being in dealing with or "processing" information must first of all sense the information. This is commonly done by reading—the eye is the "input" organ. The information is received and processed by the brain. When the processing is completed the brain must through some means or other communicate with the outside world again. This will involve some muscular activity in writing, speaking, or in actuating some mechanical control in the case of a manufacturing process. The brain conveys its results through some "output" medium.

When we turn to the digital computer, we see that it is organised in a very similar manner. To feed the information into the machine there is always some "input" unit. The core of the machine, where the processing of the information is accomplished, is the central processing unit. When the processing has been completed, the results are communicated to the operator through some "output" unit.

We must now consider in detail each of these components of the digital computer.

The Central Processing Unit

The Central processing unit is the "headquarters" of the digital computer. It contains the control unit which coordinates the activity of every part of the system. It contains the arithmetic and logic circuitry. And it contains the memory.

Binary Arithmetic

Before discussing any details of the Central Processing Unit an explanation of binary arithmetic is necessary.

Operation of the digital computer as regards both "logic" and "memory" depends, by its very nature, on manipulation or processing of numbers. The conventional number system consists of ten digits 1 to 10 and is known as the decimal or denary system. To utilise this number system mechanically or more particularly electronically ten different elements or circuits would be needed. The simplest number system possible to give an equivalent representation of the decimal system is the binary code.

The binary system is based upon the two digits 0 and 1. For example the number 29 can be written as 11101.

$29 = 2^4 \times 1 + 2^3 \times 1 + 2^2 \times 1 + 2^1 \times 0 + 2^0 \times 1 = 11101.$

Similarly

$13 = (2^3 \times 1) + (2^2 \times 1) + (2^1 \times 0) + (2^0 \times 1) = 1101.$

$10 = (2^3 \times 1) + (2^2 \times 0) + (2^1 \times 1) + (2^0 \times 0) = 1010.$

Operations in the binary system such as addition, subtraction, multiplication, division,, etc., can be quite easily performed.

Data Representation in Storage

It is surprising, on first sight, that in spite of the great complexity which it is possible to achieve with a computer, the only two words which the computer knows are "YES" and "NO". We are used to handling digits 0 - 9. The computer only knows the digits 0 and 1. Although there are some counting elements which are liable to achieve several modes of operation, computers have been built entirely around the binary mode. There is no room for ambiguity in "YES" and "NO". A valve or transistor is conducting or it is not conducting; a relay is open or closed; a magnetic spot is magnetised in one direction or the other; the magnetism in a core is clockwise or anti-clockwise; an electric charge is present or it is absent. Because it is much simpler to distinguish between two extreme states then the shades of gradation between these extremes, all computers have been defined to be, fundamentally, binary in character. Is this a limitation? It

would be possible to design a network of roads which would communicate with every city and town in New Zealand, and yet which included no crossroads; at every intersection the driver is faced with the simple choice, left or right? By executing the correct sequence of left and right turns, the driver would be able to reach any desired destination from any given starting point.

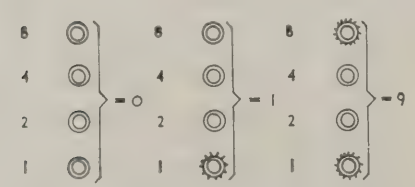
The storage of a computer consists of a vast number of elements, each of which is capable of achieving two completely separate and stable conditions. In one condition the element is said to be "ON," or to contain a bit or binary digit of information. In the other condition, the element is OFF, or there is "no bit."

Magnetic Core Storage

An element favoured in the modern computer is the magnetic core. This is about the size of a pin head or a little larger, and the shape of a doughnut. Being made of magnetic material, it is capable of being magnetised in one direction or in the reverse.

We shall consider core storage in detail for the purpose of illustration. To make the computer easier to programme the magnetic cores are often grouped so that each group represents a decimal digit. In one such system, there are six cores in each group. The first represents a 1, the second a 2, the third a 4, and the fourth an 8, and the other two are for purposes which will be explained later.

To represent an 0, no cores are on:



to represent a 1 the 1 core is on, the others off; to represent a 9, the 1 and 8 cores are on, and the others are off; all other digits are represented in a similar manner. If it is desired to represent characters other than digits, either more bits can be added to each position, thus making available the greater number of combinations, or else two digit positions are grouped together to represent a character. In this double-digit representation, A could be represented by 41, B by 42 and so on and in this manner up to 100 characters may be represented. This is more than enough provision for most purposes.

Addressing

It is not sufficient to be able to place data in storage. In order to be useful, it must be possible to retrieve the data and to make this possible each position or group of positions in storage is given an address. The storage can be likened to an array of pigeonholes, and the addresses are the labels on the pigeonholes. If we wish to find out the information relating to a particular situation, we scan the pigeon holes until we find the right label. We then look in the pigeon hole and extract the document with the desired information on it. Similarly, in a computer a particular item of information is always placed at the same address. We may obtain it from that address whenever we require it.

What is stored in the memory? Data for processing, surely. But the essence of the computer is that its programme, or sequence of instructions, is also stored in the same memory.

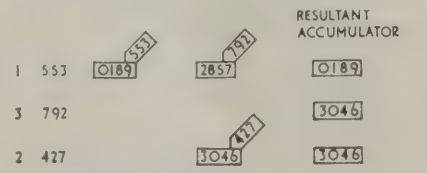
CONTROL

The Instruction

The computer, for each step in its processing, must be instructed which operation is to be performed, and on which particular item of data it is to operate.

Many computers perform their arithmetic with the aid of what is termed an accumulator. To add two quantities together in such a machine, it is necessary to place the first quantity in the accumulator, to add into the accumulator the second quantity, and then to put the result back into storage where it is required.

A programme to achieve this operation could be as follows:



Resultant accumulator

1 means clear out the accumulator and put the first quantity in it, 2 means place the contents of the accumulator in storage, and 3 means add into the accumulator. The quantities are in addresses as shown. 3046 is the result of the operation.

In the Central processing unit is an operation register which determines the function which the computer is to perform at any moment in time. To receive its order for the next operation the central processing unit goes to storage to access or find out the next instruction. The operation mode of the instruction is routed to the operation register and the address of the instruction is routed to another register. When the instruction has been assessed completely, the computer proceeds to carry out the command which it has received. When it has finished this command, it again returns to storage to receive the next instruction. The time taken to complete this cycle of operation can be as short as a few microseconds.

The whole of the operation of the computer is under the control of the stored programme. If the operation code directs the computer to assess the information from a card, the computer will wait until the whole of that information is received. If it is a division operation, the whole of the computer is given over to that divide operation for the necessary time.

Programming

It is important to realise that there is no difference in form between instructions and data. A section of storage will consist of a sequence of numbers, whether it contains data or whether it contains instructions. It is the programmer's responsibility to maintain the distinction between instructions and data. The computer is directed to obtain its instructions from a certain area of storage and the instructions will refer to data which is in a different section of storage.

Instruction Modification

What is there to prevent the programmer from arranging that

arithmetic and other operations are performed on programme and not only on the data? This procedure is not only possible, it is desirable, and almost always necessary. Indeed it is this facility for operating on the programme which brings such great power to the stored programme computer. For example, it often happens that there is a basic sequence of operations which must be performed in turn on several groups of data in storage. It is not necessary to write a separate section of programme to deal with each group of data; all that is required after performing the operation on first data group, is to modify the addresses in the instructions so that they will now refer to the second data group, and then to repeat the operation, going through that same series of instructions which has now been modified in order to address and operate on the next group of data. This procedure can be repeated as many times as is required. The general procedure is termed instruction modification.

Logic

The computer is equipped to make logical decisions as well as to perform arithmetic. This is necessary because in many examples of computation in the scientific field as well as the commercial, the subsequent operations to be performed are dependant on the results of those performed previously. Often, in a scientific operation, a programme is written to continue evaluating a quantity by successive approximation until it is sufficiently close to the required answer to proceed to the next phase of the programme. In an accounting function, it is often necessary to examine a quantity to find out if it is adequate for requirements.

For example, if in a payroll programme the man has not earned sufficient money to cover his deductions, special action must be taken. This is achieved through the logical features of the computer. Instructions are available which determine the subsequent course of the programme according to the value of a quantity which is developed by the programme itself.

Input and Output

The power of the modern central processing unit must be matched, in a balanced system, by highly specialised input and output devices. Through these raw data is given to the computer and at the end of the operation the processed results are brought out again in suitable form.

Input

Machines are being developed which are able to understand and respond to spoken commands. However, these are not yet commercially available, and as yet we must rely on a recording medium.

Punched cards, punched paper tape and magnetic tape are the common media used, and the rate of entry of the data into the computer depends upon medium. Paper tape and cards can be generated by key-driven machines, or as the result of automatic or semi-automatic processes. They are termed "primary" media for this reason. Secondary media are used for storing data which is generated by computer and which will be used for re-entry—it is a form of temporary storage and is taken out of the computer because there is not enough storage space for the data to be kept in the computer until it is required again. Cards and paper tapes are used as secondary storage media but magnetic tape which cannot be used as a primary medium is a very significant addition to the list.

A rate of 1000 characters per second is considered high for cards or paper tape, but magnetic tape can enter data at rates up to 100 times this figure. A further advantage of magnetic tape is that characters may be packed very densely so that a 400 foot reel of tape can contain as much information as a telephone directory and is roughly comparable in size.

A great deal of research is being devoted to the direct reading of printed documents. A few systems are now available commercially which will read printing directly into computer core storage. This obviates the manual key-driven process of punching cards with its relatively high cost in labour. A machine has been developed which can read the printed page and automatically punch the equivalent in Braille.

It is obvious that there will be much development in the future of automatic character and word recognition. Although it is now technically feasible, it is seldom cheap enough to be commercially practical.

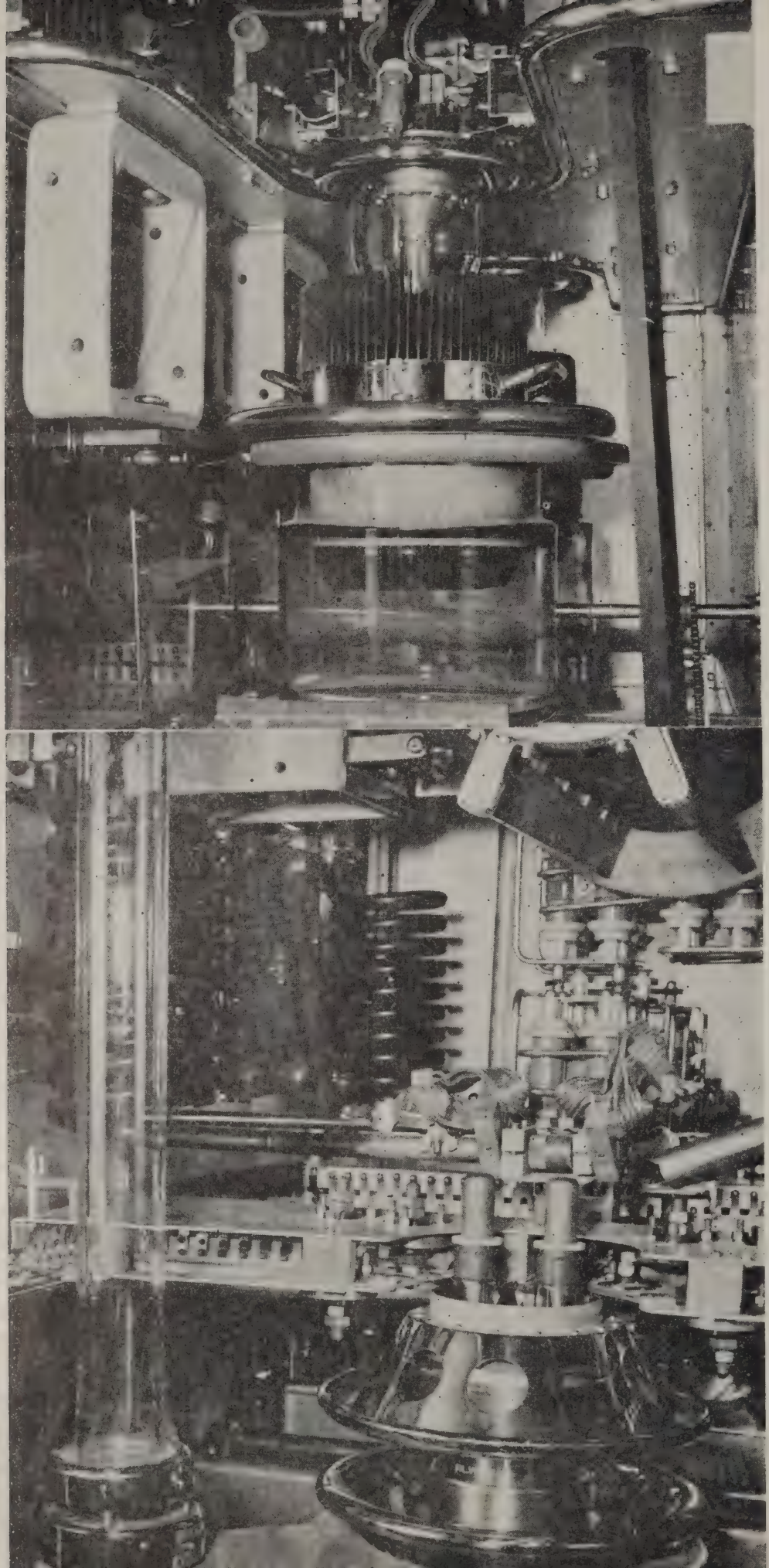
Output

The most obvious output medium is the printed page. Available printers vary from the automatic typewriter which operates at 10 characters or so per second, to line printers which have speeds greater than 1000 lines per minute. In New Zealand there are already two such printers capable of printing 600 lines per minute, which is equivalent to a character rate well over 1000 per second.

Cards, paper tape and magnetic tape are produced at speeds comparable with their respective input speeds outlined above under "Input." It has long been a standard party game for a computer to sing Waltzing Matilda or some other suitable piece. However, a more serious task for a computer is to speak directly to aircraft pilots in an air traffic control system. Such applications may be quite common in the future but at present they at least offer considerable scope to science fiction authors!

In general, the term "Data Processing System" has come to be applied to the computer which has high speed input and output units, but only moderate computing power. It is especially suitable for commercial applications with relatively high volumes of data input and output but modest computing requirements. To the layman however, such statements tend to be misleading since even a small data processing system is capable of several thousand arithmetic and logical operations per second.

The next article will show how some of the operations described here are performed electronically.



Shortwave Survey

featuring the BBC Shortwave Station at Dorset

The BBC Shortwave transmitting Station at Rampisham, Dorset, was discussed in a recent "Shortwave Listener's Corner" broadcast. We were informed that two new 100kw transmitters under construction during 1961 were now in operation alongside the four existing units which date from about 1940. The programmes, originating at Bush House, London, are sent via Post Office landline. Output from the six 100kw transmitters is fed into the station's 34 arrays and up to 18 of these are used simultaneously. An improvement in design of the new transmitters enables a change of frequency and aerial to be made within 20 seconds. Consideration is already being given to the replacement of the original equipment.

SURVEY BY COUNTRY

Greenwich Mean Time is used. Frequencies in Kilocycles. As heard in Auckland, N.Z.

* * *

CANADA. Although at good strength, the CBC on 9585 encountered heavy interference at 0630. The station announcement mentioned an alternative outlet, 11720.

* * *

CHINA was heard on 7480, a 41 metre band-fringe frequency, between 2130 and 2200 at fair strength.

Top—Penultimate R.F. Stage.
Left—The final R.F. stage showing closer view of vapour-cooled valve.

CZECHOSLOVAKIA. One more frequency to add to last month's collection is 9795, rather poor at 0500.

* * *

EGYPT. A fair signal has again been heard on 11745 which carries slow news for half an hour after 0630.

* * *

GERMANY. On Tuesday and Friday mornings, here in Australasia, from 1915 until 1930, a course of German lessons for English-speaking listeners is aired by Deutsche Welle on 15275.

* * *

INDIA. All India Radio has recently provided an excellent signal on 7235 at 1945. Also at this time 9635 is used and is usually very good until closing at 2045.

* * *

NEW ZEALAND'S external service has recently adopted a new schedule:

1700 – 1945 on 6080 and 9540 to the Pacific area.
2000 – 0545 on 15280 to the Pacific area.
2000 – 2230 on 11780 to Australia.
2245 – 0545 on 15110 to Australia
0600 – 0845 on 6080 and 11780 to the Pacific area.
0900 – 1145 on 6080 and 9540 to Australia.

Sundays only:
0815 – 0845 on 9540 to Antarctica.

Call Signs:
6080—ZL7; 9540—ZL2; 11780—ZL3; 15110—ZL21; 15280—ZL4.

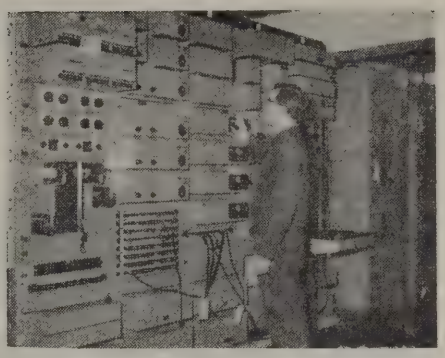
Your correspondent in Auckland has not yet heard the new outlet on 9540, and 15110 is heard very weakly around 0000.

* * *

PHILIPPINES. The Far East Broadcasting Co. at Manila has given us some good reception. At present we note the following sessions:

2330 – 0000 on 17805 (fair) and 21515 (good).

Installing Coupling Truck.



Programme Input Equipment Bays.

0015 – 0100 on 15385 (poor).
0130 – 0330 on 17805 (fair) and 21515 (excellent).
0415 – 0430 on 21515 (good).
0545 – 0630 on 11790 (fair) and 15300 (good).
0630 – 0800 on 17805 (good).
0730 – 0800 on 15300 (fairly good).
0830 – 0945 on 15300 (fairly good).
0915 – 1015 on 6030 (good).

* * *

POLAND. A weak signal from Warsaw is received here at 1930 on 7125.

* * *

PORTUGAL. Besides the afternoon transmissions on 6025 and 6185 from 0400 to 0430 which was described in March we now hear an excellent signal on 15125 in the morning from 1830 to 1930 when a programme in French takes over. The station announced as being on the 16 and 49 metre bands only.

* * *

RUMANIA. Additional sessions to those described last month have been heard. These are: at 0130 on 7195 (very weak); at 0215 on 11900; at 0315 on 7195 (excellent) and 9570 (poor); at 0430 on 11900 (heavy interference).

* * *

SPAIN. One of the shortwave outlets of the Spanish National Radio at Madrid has moved 10kc from 9370 to 9360. This is strongly heard during three sessions: 0315-0355, 0415-0455 and 0515-0555. Generally reception improves towards the final session which is heard at excellent strength. This session is also heard on 6130. The transmitter used on 9360 is notorious for its poor quality sound—a characteristic which makes it now practically unique on the shortwaves. This quality has been observed every time the signal was tuned—too many times to pass as propagational distortion.

* * *

THAILAND. The sole high powered transmitter of the Thai National Broadcasting Station (50kw) provides the only signal commonly received here. HSK9 at Bangkok, uses 11910 between 1015 and 1045 to arrive here at fair strength.

* * *

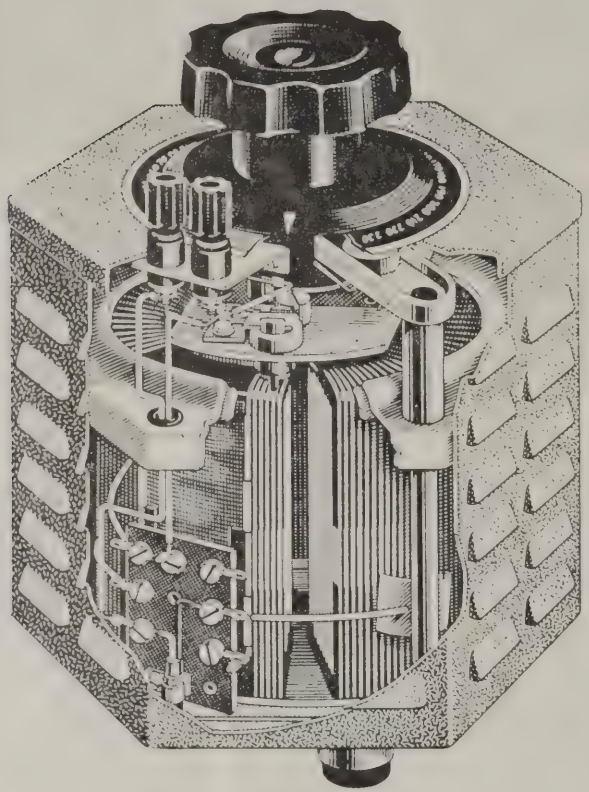
U.S.S.R. Again this winter, Radio Moscow's transmitters are blaring all through the afternoon on the 25 and 31 metre bands. A summary of this massive invasion follows:

0100 – 0200 on 11690, 11820 (fair), 1870 (good), 12010 (fair), 12030 (good).
0130 – 0555 on 9690 (quite good after 0400), 11735 (excellent).
0200 – 0300 on 9745 (poor), 12030 (excellent).
0345 – 0555 on 9665 (better after 0400).
at 0345 on 9700 (interference).
0430 – 0500 on 9570 (interference) and 11960 (fair).

* * *

We remind readers to add 12 hours to the above times to obtain New Zealand time or add 10 hours for Australian Eastern Standard Time.

PHILIPS *Variable transformers*



Philips variable transformers are designed and manufactured with such care that they will give reliable service over a long period of life. They are available mounted in a durable, attractive case or without the case for panel mounting.

★ Can be mechanically coupled for series, parallel or 3-phase (star connected) operation.

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★ Suitable for ganging and combining.

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New Midget Television

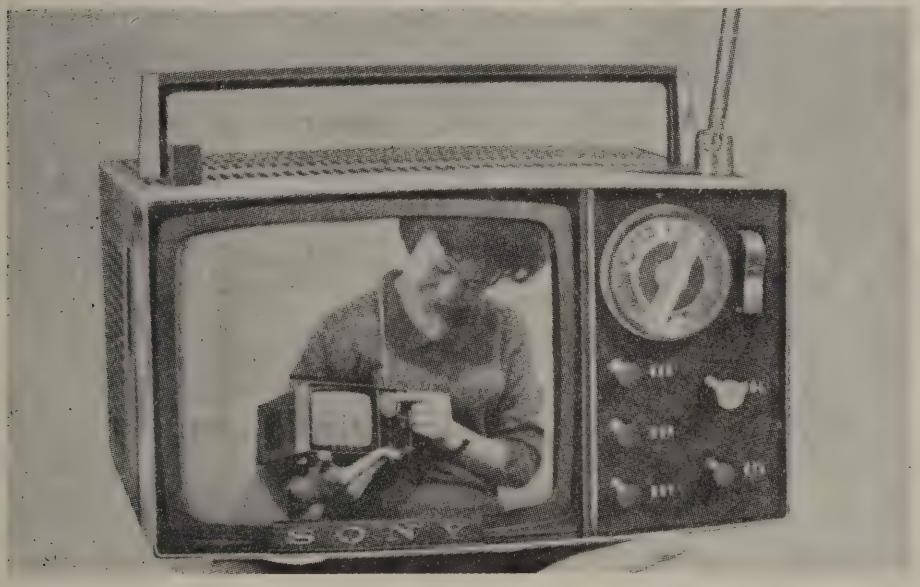
Sony Corporation officially announced the appearance of a revolutionary all transistorised 5in. picture tube personal "Micro TV" on April 17, 1962, in Tokyo.

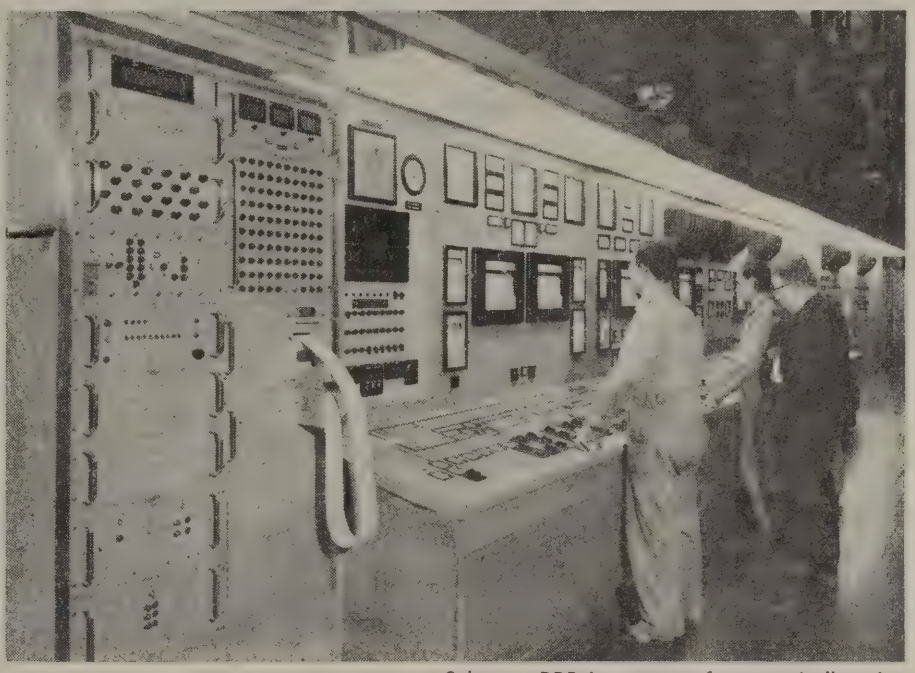
The Sony "Micro TV" model 5-303 is the world's lightest—weighs only 8 lbs., and the world's smallest—7⅝in. (W) × 4¾in. (H) × 7¾in. (D).

It can be used not only with the house current, but with the 12V car battery, specially developed pulse AGC system and ANS system avoids interference by irregular reflected waves during travelling and assures stable operation on the 12V car battery. It can also be operated with its rechargeable battery. Its power consumption is very small; 13 watts A.C., or less than 10 watts D.C., which is only 1/10 of that of ordinary TV.

It uses 24 transistors including 3 epitaxial transistors and 5 mesa transistors, and 20 diodes.

Although "Micro TV," like the transistor radio, is the most ideal form for exports. Sony is planning to sell it only in Japan until such time as the production reaches the point where enough quantity becomes available for export.





Solartron DDR in process of automatically printing a record of the scan of the 400 channels.

Solartron Digital Data Recorder System

Twelve months ago The Solartron Electronic Group Ltd. delivered to N.V. Provinciale Noordrabantsche Electriciteits-Maatschappij (P.N.E.M.) a Digital Data Recording System to be installed in an electrical generating plant which is situated in the North Brabant area of Holland.

This electrical power generating station has the largest steam generating plant in that particular area of Europe.

The engineers and administrators of this organisation, together with Solartron technicians, discussed the problem of the new techniques of data recording and logging, as a result of which Solartron were contracted to supply a 400 channel Digital Rata Recorder.

The equipment was built to record information from 400 sources comprising temperatures ranging from 20°C to 700°C, using 300 thermo-couples and 50 resistance thermometer bulbs, with 50 additional channels available for recording plant control conditions.

The system has facilities for setting up 21 alarm levels, and any one of 400 inputs can be programmed to refer to these alarm levels, or as many as 50 inputs may be referred to any one alarm level for detecting off limit conditions.

The purely automatic operation of the system is looked after by the Digital Clock and the alarm incorporated, the 400 input points can be scanned continuously at a rate of four per second and if required a printed record can be made of all channels at regular intervals or on demand.

Alarm signals are set so that if inputs exceed pre-set references an alert is given. Any one input channel selected on the control panel can be continuously monitored and recorded and if necessary the system can be made to operate under alarm conditions only, or to register in connection with the Solartron High Speed Printer, off limit values.

The system can also be tailored to give continuous printed record through the Solartron High Speed Printer or can operate through any one of the known electric typewriters.

The photograph illustrates the Solartron 400 channel Data Recorder installed at P.N.E.M., Geertruidenberg.

The Solartron Electronic Group Ltd., New Zealand Agents, E. C. Gough Ltd., Christchurch.

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AA 201 E	STEREO AMPLIFIER	**Was** £24/4/8	**Now**	**£22/16/–** plus ST
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Book Reviews . . .

The Amateur Radio Hand Book—Third Edition, Published by the Radio Society of Great Britain, 28 Little Russell Street, London, W.C.1.

It was some 16 years ago that the R.S.G.B. published the last printing of its now well known Second Edition of the Amateur Radio Handbook. Aided by a large number of experts in particular fields, the Society has produced a 500 page handbook covering all the most modern technical trends in use in the amateur radio services. Although it is currently describing equipment and designs of prominent English origin, these factors make it eminently useful to the New Zealand radio enthusiast, as many of our basic sources of components and equipment originate in the United Kingdom. The handbook commences with a comprehensive section on fundamentals and thermionic valves. The following section on semi-conductors, however, is rather disappointing, only in that it does not give details of the latest types of semi-conductor equipment, but is conservative in describing the more classical and typical applications of semi-conductors.

In the section on High Frequency receivers and transmitters, however, this publication is well up to date and is noteworthy for the simplicity of approach to the various constructional sections on the V.H.F. receivers and transmission equipment, where designs suitable for use in this country are prominent. The sections on keying and modulation appear to be more than adequately covered, whilst the chapter on the newer techniques of Single Side Band Transmission and reception is a useful text in itself. Other sections on aerials and power supplies are well-covered, whilst the chapter dealing with mobile equipment makes interesting reading for the mobile enthusiast. Other sections on interference, noise, and measurements are very useful references for the amateur.

However, this textbook also holds much for the electronic engineer as it is well indexed and has a generous section on data, formulae, etc.

This is a handbook which we can thoroughly recommend. Our copy from John Gilbert & Co. Ltd.

* * *

Industrial Control Electronics: By Matthew Mandl of Technical Institute, Temple University. Published by Prentice Hall Inc., New Jersey.

In New Zealand the Electronics field in the province of industrial control is rapidly widening. This textbook serves as a useful foundation for the study of many aspects of Industrial Electronics and control systems as it includes basic circuits, control devices, transducers, relays and solid state equipment as well as some of the practical equipment associated with these various fields.

The initial chapters discuss control signals and various devices for producing, amplifying and sensing these signals. This is followed by chapters on basic amplifier systems, oscillator systems, including those used for astable and bistable circuits, and sawtooth waveform generation.

In each case the typical thermionic amplifier design is followed by the similar transistor or other semi-conductor circuits, so direct comparison can be made.

The succeeding chapters on coils and reactors, generators, and rectifiers and power supplies are once again both fundamental and easy to understand, and yet sufficiently specific so as to quote actual working equipment.

As we proceed into the next section on transducers and photo-electric equipment, the trend to the more practical details become apparent. Industrial equipment, for example, thyratons and semi-conductor switches, are also covered, followed by an interesting chapter on the application and circuitry of servo-mechanism. The main section of the book concludes in chapters on magnetic and dielectric amplifiers, counters, indicators and control circuits. The last few pages discuss some practical industrial applications, and this is followed by an appendix setting out industrial electronic symbols, together with a reasonably comprehensive index.

Whilst making a useful text book, this publication, having been published late in 1961, is a useful adjunct to the electronic engineer's library.

Our copy by courtesy Technical Books Ltd.

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5 OF THE MANY NEW BOOKS RECEIVED AUGUST-SEPT.

Transistors—How to Test Them—Gernsback 94, 19/6. Super Radiotron Valve Manual—R.C.A., 17/6. Transistor Subminiature Receivers for the Home Constructor, 6/9. Transistor Substitution Handbook—Sams, 15/-. Handbook of Semi-conductor Electronics—Hunter (McGraw Hill), 1962 Ed., 166/6.

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LOOKING AT

another 4 layer diode

Just recently two research workers have produced a new 3 terminal PNPN switch which can be turned on and off with the base region of the semi-conductor. Allegedly, the semi-conductor industries first alloyed 4 layer device—the "Dynaquad"—has just been introduced by Tung-Sol Electric Incorporated.

It has 5 natural features which make it a highly practical component. These are:

1. It is a natural switch.
2. It has both "turn on" and "turn off" control at the base.
3. It uses an established and reliable design.
4. It is significantly lower in cost than comparable components.
5. It leads to substantial circuit simplification and economy.

A Description of the Device:

The "Dynaquad" is a germanium three terminal PNPN device and is shown symbolically and diagramatically in Fig. 1 and 2. Basically it is a two position switch capable of working at high speed as it switches at speeds in the megacycle range, with rise times of the order of 1/10th of a microsecond. It is capable of producing an output voltage swing of up to 35 volts. Because of its bistable nature, a single "Dynaquad" can replace a number of transistors and associated components in many applications, and in simple on-off switching it behaves as a pulse operated latching relay devoid of bounce, shatter and sticking contacts.

Mode of Operation:

In its normal operation, this device is "turned on" by applying a small negative pulse to the base and it will remain on after the signal is removed. "Turn-off" is achieved by applying a positive pulse to the base, or alternatively by reducing the collector current below the sustaining point.

The theory of operation of the "Dynaquad" can be roughly examined by using a two transistor analogy as shown in Fig. 3.

The first stable state is the "off" condition. Here the only current flow is the leakage currents through the device. If now a small base/emitter current is caused to flow in T1, then an amplified collector current for T1 will flow. This current becomes the base drive current for the base emitter junction of T2 causing an increased collector current to flow in T2. This now becomes the injected current into the base of T1—the system becomes self-regenerative and the collector current of the device increases to a value limited only by the circuit impedances. This is the second stable state—being fully saturated. In order to turn the device off the regenerated current must be interrupted. This may be accomplished by either reducing the collector supply current below a value sufficient to sustain the regenerated condition or secondly by injecting a reverse current into the base sufficient to stop the regenerated current.

Improved Manufacturing Techniques:

The "Dynaquad" represents a significant departure in the design of multilayered devices. Conventionally, the 4 layers are formed by multiple diffusion and critically controlled etching. There are some variations of this but in all cases the junction formation or the final fabrication requires systems and controls which are considerably more complex and costly than the alloyed junction transistor. With this semiconductor, a process has been developed for forming multiple junctions with the same simplicity and reproductability as for single alloy junctions.

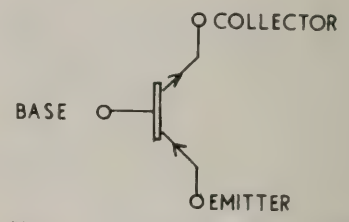

FIG.1 DYNAQUAD CIRCUIT SYMBOL

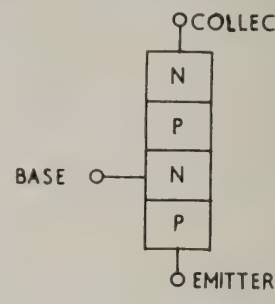

FIG 2 THE PHYSICAL REPRESENTATION

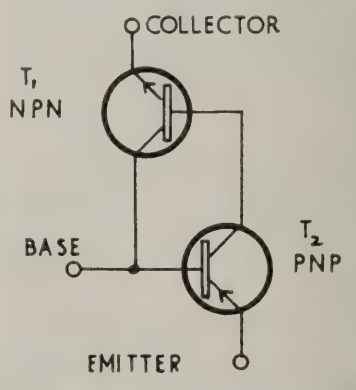

FIG 3 THE TWO TRANSISTOR ANALOGY

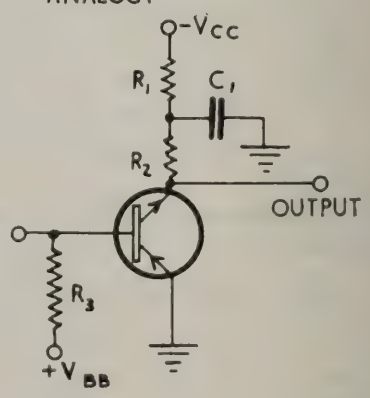

FIG.4 CIRCUIT OF A MONOSTABLE MULTIVIBRATOR

General Applications:

The two stable states of the "Dynaquad" mean that it is an efficient component in any applications where digital techniques are required. Flip-flops, counters, registers and logic devices can be accomplished with a considerable saving in components, labour and space.

A single "dynaquad" can be operated in the three basic multivibrator modes—monostable as in Fig. 4; astable as in Fig. 5; and bi-stable as in Fig. 6.

In Fig. 4. R1 is made large. When the device is off, C1 charges up to —Vcc. A negative pulse applied to the base of the system turns it on and C1 discharges through the collector, thus producing the output pulse. When the condenser has discharged the collector voltage drops nearly to zero thereby turning the device off again.

In the circuit shown in Fig. 5 where the "Dynaquad" is operating in an astable condition whilst the unit is "off" C1 charges up to a potential determined by R_1, R_2, R_3 and R_4. At the same time the emitter is back biassed by the voltage drop across the diode II. When the base voltage exceeds the emitter voltage as it does because it approaches —Vcc as C1 charges up, the base starts to draw current, and when this becomes sufficient, the switch turns on. This action discharges C1 through C2, producing a collector pulse. The collector voltage now drops towards ground, also dropping the base potential below the emitter so that the device turns itself off again, setting itself to repeat the cycle.

A slightly more elaborate circuit is used to make the "Dynaquad" into a bistable multivibrator in which pulses of the same polarity can turn the device on and off. It can be used as a triggered pulse generator in which input pulses are converted to rectangular waveforms having half the input frequency. In addition it can act as a phase inverter system producing two trains of pulses 180 degrees out of phase with each other.

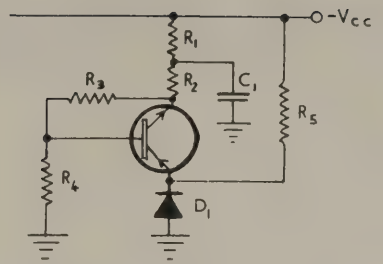

FIG.5 DYNAQUAD CIRCUIT ILLUSTRATING BISTABLE CONDITION

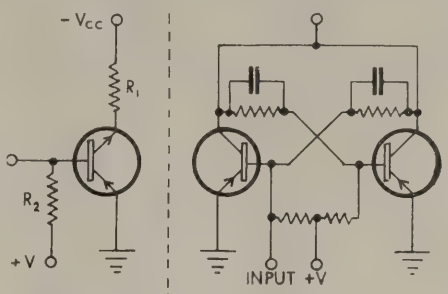

FIG.6 DYNAQUAD FLIP FLOP AT LEFT ILLUSTRATING GREAT CIRCUIT SIMPLIFICATION

Typical of the kind of circuit simplification that is possible with the "Dynaquad" is the flip-flop circuit shown above in Fig. 6. Here one "dynaquad" replaces seven components in the conventional transistor flip-flop circuit.

When a negative pulse is applied to the "Dynaquad" base, the unit turns on. This raises the output from —VCC to zero voltage. A positive pulse applied to the base turns the unit off, changing the output from zero volts to —VCC.

This new product will have many uses from counters through computers and logic systems to automatic control systems, telephone exchanges, etc. It is one of a new concept of 4 layer devices. Already we have dealt with several types in the last few months in this magazine and already others are appearing on the horizon.

References:

"A new 3 terminal PNPN Switch Simplifies Fast Logic Circuit Design," by A. F. Cake and D. E. Richards of the Applications Dept. Tung-Sol Electric Inc., New Jersey.

"Electronics and Communications," October, 1961.

Recent Advances in Solid-State Electronics

Continued from page 15

tors in the form of a long germanium crystal.

When the ribbon-like crystals are cut into segments, only simple processing is needed to produce transistors at a yield very near 100 per cent. By this method lengths of ribbon have been produced along which small multiple-junction subsystems are distributed, Figure 3. Since these ribbons can easily be processed to become a long series of tiny amplifiers, it is not at all facetious to say that this ribbon can be snipped into lengths to give us amplifiers of whatever gain is desired.

A more recent and extremely significant achievement resulting from research is that it has now been discovered how to grow multizoned crystals as dendrites, directly from the furnace melt. This development is regarded as a major event in new technology of molecular electronics. It makes available basic building blocks having at least three layers of zones and two interfaces. Thus it will no longer be necessary to perform many operations to create multizone elements.

In considering the implications of this basic method for crystal growth, one most interesting possibility is that it will prove practical to combine the ability to grow multizoned crystals with the ability to perform operations in the crystal at the time it is growing in the furnace. Admittedly, to achieve near automatic production of semiconductor devices and molecular electronic function blocks is a long-range objective, but it is probable that it will eventually be able to "Grow" from a pool of molten semiconductor materials some items of electronic equipment that today are of the order of complexity of radio receivers and amplifiers.

(To be concluded)

Electron Tube Interchangeability Guide

PART THREE

In this country we have electron tubes from many sources and duplication of types with differing numbers has been a major source of confusion. This chart is intended as a general guide for interchangeabilty for receiving and industrial tubes. Compiled originally by Mullard Ltd. and International Electronics, the chart naturally cannot be all inclusive but presents some of the more common tubes that are in general use both in New Zealand and Australia and also the Northern Hemisphere.

U.S.	European
0A2	150C4
0A2WA	M8223
0A4G	Z300T
0B2	108C1
0B2WA	M8224
0D3	150C3
0E3	85A1
0G3	85A2
1AD4	DF62
1CP1	DH3-91
1N87	OA70
1N476	OA81
1N478	OA85
1N480	OA86
1N541	OA79
1N542	2-OA79
1N616	OA73
1N617	OA91
2D21	EN91
2D21W	M8204
2J42	JP9-7
2J42A	JP9-15
2J56	JP9-50
2N24A	OC77
2K25	KS9-20A
2N115	OC16
2N279	OC70
2N280	OC71
2N281	OC72
2N282	2-OC72
2N283	OC73
2N284	OC76
2N577	OCP71
3ALP1	DG7-5
3AMP1	DG7-32
3B28	RR3-250
3C45	XH3-045
3NP4	MW6-2
3WP1	DG7-36
3WP11	DB7-36
4-65A	QY3-65
4B32	RR3-1250
4C35	XH8-100
4X150A	QV1-150A
4X500A	QY4-500A
5ABP1	DG13-34
5ADP1	DG13-34
5ADP7	DP13-34
5ADP11	DP13-34
5C22	XH16-200
5CP1A	DG13-2
5CP7A	DP13-2
5CP11	DB13-2
5FP4A	MW13-35
5FP7A	MF13-1
5FP11	MB13-1
6D4	EN93
6J4WA	M8232
7AHP1	DG16-22
7AHP7	DP16-22
7AHP11	DB16-22
12AT7WA	M8162
723A/B	KS9-20
807	QV95-25
813	QY2-100
829B	QQVO7-40
832A	QQVO4-15
833A	TY4-350
866A	RG3-250A
1267	Z300T
2050	EN32
5544	XR1-3200-5544
5545	XR1-6400-5545
5557	XG5-500
5559	XG1-2500
5636	5636
5644	5644
5651	5651
5654/6AK5W/6096	M8100
5672	DL620
5678	DF60
5696	EN92
5718	5718
5725/6AS6W	M8196
5726/6AL5W/6097	M8212
5727/2D21W	M8204
5763	QVO3-12
5783WA	M8190
5802	ME1401
5820	5820
5823	Z900T
5840	5840
5861	TDO3-10
5866	TY2-125
5867	TY3-250
5868	TY4-500
5889	ME1403
5894	QQVO6-40A
5895	QQZO4-15
5899	5899
5902	5902
5920	E90CC
5923	TY6-5000W
5924	TY6-5000A
5949	5949
6005/6AQ5W	M8245
6021	6021
6507	M8137
6058	M8079
6064	M8083
6065	M8161
6075	QY5-3000W
6076	QY5-3000A
6077	TY12-50A
6078	TY12-50W
6079	QY5-500
6080	6080
6084	E80F
6085	E80CC
6096	M8100
6097	M8212
6100/6C4WA	M8080
6101/6J6WA	M8081
6146	QVO6-20
6155	QY3-125
6156	QY4-250
6189/12AU7WA	M8136
6205	6205
6211	6211
6227	E80L
6252	QQVO3-20A
6354	150B2
6360	QQVO3-10
6370	E1T
6373	DL70
6374	EY84
6375	DC70
6391	EF74
6487	EF70
6488	EF73
6489	EA76
6516	M8082
6611	DF61
6686	E81L
6687	E91H
6688	E180F
6689	E83F
6693	RG4-3000
6778	EC70
6779	Z803U
6786	XG5-10
6807	XR1-6400A
6922	E88CC
6923	EA52
6939	QQVO2-6
6960	TY7-6000W
6961	TY-6000A
6972	JP9-75
6977	DM160
7001	M8167
7004	TD2-3000A
7062	E180CC
7091	JN2-2.5A
7092	TY6-800
7118	E181CC
7119	E182-CC
8020	RY12-100

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Record Review

by Professor C. G. F. Simkin

KEY:

- ● Not recommended because of poor performance or recording.
- ★ Recommended although the performance or recording has faults.
- ★★ Strongly recommended because both performances and recording are excellent.

★★ PROMENADE CONCERT, played by the Nordwestdeutsche Philharmonic Orchestra, conducted by Wilhelm Schuchter. World Record, TZ158.

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Their concert opens with a vivid performance of Tchaikovsky's "Cappricio Italien"; it comes across with brilliant and accurate colour for all sections of the orchestra. This high standard is maintained in Dvorak's quieter "Slavonic Dance" (No. 2) with warm, sensously sweeping passages for strings and skilfully contrasting moods and tempi. Then comes Berlioz's stirring "Hungarian March," which receives all the "cataclysm of sweeping fury and thunder" that the composer demanded.

Most of side two is given to "Bolero," a favourite of many, but a work which I find boring and sufficiently condemned by Ravel's own description of it as "orchestral effects without music." There is compensation in Debussy's hauntingly beautiful and imaginative "L'Apres-midi d'un Faune," which is given a sensitive interpretation that I find very satisfying.

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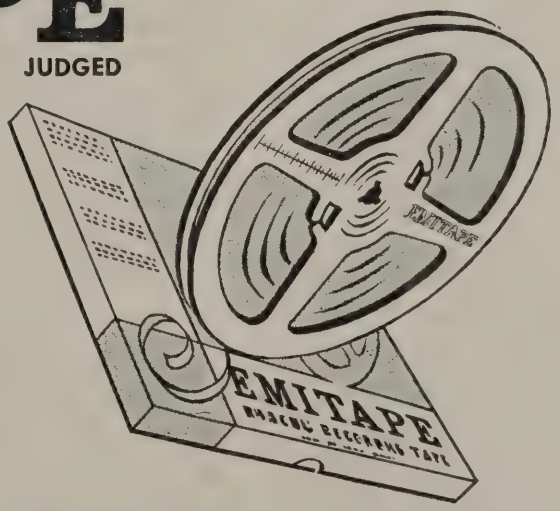

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PT	**7**	115/V ½ Wave	65 Ma.					
PT	**8**	280/280 V	80 Ma.	6.3 V	3 Amp.	5 V 2 Amp.		
PT	**9**	310/310 V	80 Ma.	6.3 V	3 Amp.	5 V 2 Amp.		
PT	**10**	350/350 V	80 Ma.	6.3 V	3 Amp.	5 V 2 Amp.		
PT	**11**	310/310 V	100 Ma.	6.3 V	4 Amp.	5 V 2 Amp.		
PT	**12**	350/350 V	100 Ma.	6.3 V	4 Amp.	5 V 2 Amp.		
PT	**13**	310/310 V	125 Ma.	6.3 V	4 Amp.	5 V 3 Amp.		
PT	**14**	310/310 V	150 Ma.	6.3 V	5 Amp.	5 V 3 Amp.		
PT	**15**	400/400 V	150 Ma.	6.3 VCT	5 Amp.	5 V 3 Amp.		
PT	**16**	400/400 V	150 Ma.	6.3 VCT	2 Amp.	5 V 3 Amp.	6.3 V 4 Amp.	
PT	**17**	450/450 V	150 Ma.	6.3 VCT	2 Amp.	5 V 3 Amp.	6.3 V 4 Amp.	
PT	**18**	450/450 V	200 Ma.	6.3 VCT	2 Amp.	5 V 3 Amp.	6.3 V 4 Amp.	
PT	**19**	500/500 V	200 Ma.	6.3 VCT	2 Amp.	5 V 3 Amp.	6.3 V 4 Amp.	
PT	**20**	595/595 V (500 V DC)	350 Ma. Choke Input					
PT	**21**	890/890 V (750 V DC)	250 Ma. Choke Input					
PT	**22**	295/295 V	360 Ma.	6.3 V	10 Amp.	5 V 3 Amp.	Sec. Tapped 240/240 V	
		Suitable for use with either RCA or Philips TV Kits Primary 0.210, 220, 230, 240 V.						
PT	**23**	Deleted						
PT	**24**	Pri. 0-230-270 V		6.3 V	5 Amp.	6.3 V 5 Amp.	5 V 2 Amp.	
		Used in TV Receiver with Mains Rectification.						
PT	**25**	115 V 360 Ma. 12.6 V 5 Amp. CT used with Silicon Diodes in Voltage Doubler Circuit.						
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PT	**27**	280/280 V	125 Ma.	6.3 V	5 Amp.	CT 6.3 V 1 A.		
PT	**28**	280/280 V	175 Ma.	6.3 V	4 Amp.	CT 6.3 V 4 A.	CT 5 V 3 A.	

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"Magnetostrictive Delay Lines," by A. P. C. Thiele (formerly Cossor Radar and Electronics Ltd.).

"Quality Assurance in Transistor Manufacture," by O. M. Elkins (Texas Instruments Ltd.).

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"Transistor Amplifier with Adjustable Impedance and Gain," by J. J. Tiemann (G.E.).

"Low Cost Pulse Generator," by R. G. Ryan (University of N.S.W.).

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"Transistorised Voltage Regulators," design data on the three basic types of regulating systems.

"The TR24"—a 24 watt Transistorised High Fidelity Amplifier.

Electronic Engineering—May 1962—U.K.

"An Electronic Desk Calculating Machine," by L. Molyneux, B.Sc., PL.D., Durham University.

"A Transistor A.M.—F.M. Receiver," by L. E. Jansson, A.M.I.E.E., of Mullard Ltd.

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"Current Stabilised Transistor Power Supplies," by F. W. Lovick, B.Sc., of Dept. of Physics, University of Birmingham.

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"Graphical Determination of the Operating Point of an Emitter-Follower," by K. G. Nicols, M.Sc., of University of Southampton.

Q.S.T.—May 1962—U.S.A.

"A Simple 420 Mc. Transceiver," by W. Lange, WIYDS Laboratory Assistant QST.

"Keeping Track of Oscar," R. W. Burhams, W8FKC and R. E. Rankins W8CWL of the Research Dept. Standard Oil Coy., Ohio.

"Simple Wavemeters for VHF Beginners," by L. G. McCoy, W1ICP, Technical Assistant QST.

"A Small Tilt-over Mast for Roof-Top," by F. Gue, VE3DPC.

"A Hand-Portable Kilowatt (P.E.P.) Linear with Power Supply," by J. Jennings, W6EI, of Jennings Radio Mfg. Co., San Jose, California.

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"Some Two-metre Front Ends," Using the Nuvistor and Transistors.

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LOCAL NEWS

Neeco Now in the Hutt

The National Electrical and Engineering Co. Ltd. has pleasure in announcing to its many customers in the Hutt Valley that it is opening a new depot at the corner of Marsden and Bridge Streets on

MONDAY, JULY 2nd, 1962.

NOTE THE PHONE No. 61-326.

The Company will be represented at its new depot by Mr. Lin Curley, assisted by Mr. Jeff Wagg from their Wellington Warehouse. In addition to providing a more direct and prompt service, because of the proximity of the depot, they will be able to offer more personalised service.

Another Television O.B. Vehicle Ordered—Queen's Visit Deadline

The New Zealand Broadcasting Corporation has placed an order with Amalgamated Wireless (Australasia) N.Z. for the supply of another Marconi Television Outside Broadcast vehicle. This is the third Marconi O.B. Van for New Zealand. Speed is the keynote in this instance for the O.B. unit has to be in New Zealand in time to cover the visit of H.M. the Queen in February next.

The vehicle, which is for use at the Wellington television station is to be supplied with three Marconi Mark IV 4½-inch Image Orthicon Camera channels, with provision for a fourth. Additional cameras have also been ordered for the two Marconi O.B. vehicles previously on order; one vehicle is already in service in Auckland and the second for use in Christchurch, will be delivered later this year.

Press Information

Mr. D. Hendry, Export Manager for the Solartron Electronics Group, will be visiting Australia for the Technical Exhibition to be held at the time of the Anzaas Conference in August, and will be paying a brief visit to New Zealand shortly afterwards.

Overseas Notebook . . .

Microwave Radar Links For Norway

Marconi's Wireless Telegraph Company Limited have been awarded a substantial contract by the Royal Norwegian Air Force for the supply and installation of two microwave radar links for incorporation into Norway's defence system as part of the N.A.T.O. Infrastructure programme.

The contract, which is to the approximate value of £500,000, was obtained in the face of intense competition.

No details of the equipments or their intended locations can be given on security grounds, but it can be said that they are intended to carry complex search and height-finding radar signals from the radar heads, for display and processing at Control Centres. The radar stations themselves will be operated by remote control over the links.

This follows on the completion of previous important contracts from the Norwegian Ministry of Defence, which include a £1,000,000 order in the Autumn of 1958 for two high-power, long-range radar control and reporting stations and supplementary equipment.

The new order was obtained through Norsk Marconikompani, the Marconi agents in Norway.

* * *

Electronic Counter Measures Time and Frequency

A completely transistorised high speed counter, capable of time and frequency measurements, has been developed by a British firm. It enables frequencies up to 50 microseconds and time intervals from one microsecond to over 1000 days to be measured. With the addition of a sensing device, period measurements can also be made.

A new feature of the counter is that the indicator consists of a large eight figure in-line display unit on which both the units of measurement and the decimal point are shown. The count is continued when necessary on a five digit electromechanical counter which can be reset. It can be reset automatically or manually, the latter being operated remotely if required. Facilities are provided to allow a printer to be operated from the counter to enable permanent records of the readings to be made.

The principle of operation for time measurement is that of counting the number of cycles of a standard oscillator occurring during the measured period.

For frequency measurement, the standard oscillator gates the input signal for a controlled period, during which the cycles of the input signals are counted.

Airmec Ltd., High Wycombe, Buckinghamshire, England.

* * *

Westinghouse Signs License Agreement With Teleprompter

NEW YORK—Westinghouse Electric Corporation has been licensed by the TelePrompTer Corporation to manufacture and market tape recording equipment for the home instrument field.

O. H. Yoxsimer, general manager, Westinghouse television radio division, and Irving B. Kahn, chairman of the board and president of TelePrompTer, said the equipment to be produced is based on radically new engineering techniques developed in the TelePrompTer laboratories.

Mr. Kahn said the Westinghouse rights are "for five years with substantial minimum royalty guarantees."

TelePrompTer's Weathers Industries Division will apply the new method of tape handling to the high-fidelity components field in products to be introduced later this year. The company also retains rights to develop the process in such fields as business information and dictating machines.

Mr. Yoxsimer said the new tape handling principle provides vastly improved performance characteristics under low tape tensions hitherto not possible in general purpose recorders.

The tape transport utilises a simplified mechanism permitting reduction in tape tensions in the magnitude of ten to one over comparable recording instruments on the market today, facilitating the use of thinner and less expensive tape and providing more playing time in a smaller reel or cartridge configuration, Mr. Kahn explained.

An inherent advantage of the driving system is that the basic recorder is compatible for either reel-to-reel or cartridge operation. It also can be adapted to use with a high quality turntable with minimum accessories.

The tape handling method is based upon techniques evolved by John Fundingsland of the TelePrompTer engineering staff and developed under direction of H. J. Schlafly, Jr., vice-president, engineering, and Ray Wadsworth, director of product engineering.

Westinghouse Electrical International Co.

* * *

Kenya to Have Television

Kenya is to have television before the end of this year and has "bought British" to establish the public service.

Marconi's have been entrusted with the order for the supply and installation of the main items of transmitting and studio equipment. Formal contracts are being placed by Television Network (Kenya) Ltd.

The transmitting equipment will include a 5kW vision transmitter Type BD 372A, a 1 kW sound transmitter Type BD 324, a 3-stack super-turnstile aerial Type BD 760 (giving an E.R.P. of 15 kW), programme input equipment, a filterplexer, a water-cooled test load, harmonic attenuators and a considerable quantity of other ancillary equipment.

Marconi studio equipment will comprise three Mark IV image orthicon camera channels, four vidicon camera channels Type BD 871, a transistorised sound control console Type BD 968, picture monitors, some master control equipment, film projectors and ancillary equipment. One of the BD 871 camera channels will be used in the announcer's studio and the others for telecine purposes.

BIG STRIDES TOWARDS PERFECT SOUND REPRODUCTION

(Continued from page 11)

extremely high quality to meet "hi-fi" demands. The United States of America, in particular, calls for a large part of the British output, and one firm, Garrard Engineering and Manufacturing (10), is at present exporting some 70 per cent of its production. An outstanding model from this firm is the "Autoslim Deluxe," which is the first turntable of transcription quality to incorporate a record changer. Throughout the stock of records on the changer, the pressure of the stylus does not change from first to last record.

Key to organisations and manufacturers of products mentioned:

(1) H. J. Leak & Company Ltd., Brunel Road, Westway Factory Estate, London, W.3.

(2) Wharfdale Wireless Works Ltd., Idle, Bradford, Yorkshire, England.

(3) Accoustical Manufacturing Company Ltd., Huntingdon, England.

(4) Clarke & Smith Manufacturing Company Ltd., Melbourne Road, Wallington, Surrey, England.

(5) Mullard Ltd., Mullard House, Torrington Place, London, W.C.1.

(6) Audio Manufacturers' Group (British Radio Equipment Manufacturers' Association), 49 Russell Square, London, W.C.1.

(7) Brenell Engineering Company Ltd., 1-A Doughty Street, London, W.C.1.

(8) Truvox Ltd., Neasden Lane, London, N.W.10.

(9) E.M.I. Electronics Ltd., Hayes, Middlesex, England.

10) Garrard Engineering & Manufacturing Company Ltd., Newcastle Street, Swindon, Wiltshire, England.

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G.E.C. switching transistors for high speed operation!

One hundred and twenty millimicroseconds—that is the rise time which can be obtained using G.E.C. germanium p-n-p transistors. Peak collector current rating is 150 mA, and maximum junction operating temperature 85°C.

The GET 871, GET 872 and the new GET 875 are designed for use in computers, scaling units, counting circuits, shift registers, waveform generators and similar applications. These transistors are immediately available from stock.

Type	Maximum Ratings					Minimum h_{FE} $V_{ce}=-1V$, $I_c=25mA$	Minimum f_α (Mc/s) $V_{cb}=-6V$, $I_e=1mA$	Maximum V_{eb} (mV)	Maximum $V_{ce(sat)}$ (mV)	Typical Transient Response (for circuit details, see data sheet)	
	$V_{cb(pk)}$ (V)	$i_{c(pk)}$ (mA)	$T_{j(w)}$ (°C)	P_t (max) (mW) 35°C	P_t (max) (mW) 55°C			$I_c=25mA$, $I_b=0.83mA$		t_r (μs)	t_f (μs)
GET871	—15	150	85	75	45	20	3	400	250	0·18	0·07
GET872						30	7	400	250	0·14	0·04
GET875						50	15	400	250	0·12	0·04

Fuller information is available on request. G.E.C. also makes a range of high-speed switching diodes, described in Semiconductor Application Report No. 14.

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